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LXVIII

HEMANGIOMAS OF THE MOUTH

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ROCHESTER, MINN.

Hemangiomas are often encountered about the face and neck and those presenting externally may also involve the oral cavity. However, lesions of this type limited to the interior of the mouth are only infrequently seen. Those affecting the buccal cavity alone or in conjunction with other structures at times attain considerable size, produce marked deformity and dysfunction, are subject to frequent trauma and to recurring acute inflammatory processes and may give rise to serious and even fatal hemorrhage. Treatment is advisable for many of these tumors but the type of treatment and the optimal time for administering it varies in different cases.

These benign blood vessel tumors are congenital or appear shortly after birth and are of several distinct types. Much confusion regarding the nomenclature of the various forms of hemangiomas exists in the literature and many authors have presented their own classification. In general there are two principal types, the capillary and the cavernous. However, noteworthy differences in the clinical and histologic features render subdivision of both of these groups essential.

Read at the meeting of the American Laryngological Association, St. Louis, Mo., April 23-24, 1947.

a
b

a
b

Fig. 1.—Small vascular lesion of the lower lip, probably traumatic in origin. The blue-black color of this lesion suggested the possibility of a melanoma.

Fig. 2.—*a*, Cavernous hemangioma of the lower lip; *b*, result following electrocoagulation and plastic procedure.

Fig. 3.—*a*, Actinodermatitis with extensive malignant change resulting from excessive radiation of a capillary hemangioma (port-wine stain); *b*, result seven years following excision and repair with pedicle flap.

The capillary hemangiomas include the port-wine stain or nevus flammeus and the strawberry birthmark or hemangioma simplex. Lesions of the latter type are circumscribed, finely lobulated, slightly elevated new growths composed of dilated capillaries, veins and arterioles. They are bright red to purple in color and may occur on any part of the surface of the body but are most common on the face, trunk and the arms. The lips, especially the upper lip, frequently are involved. I have not observed this type of hemangioma inside the mouth.

Capillary hemangiomas of the port-wine stain type are usually flat, nonelevated lesions varying in color from faint pink to bright red or magenta. Microscopically these present in the skin a narrow zone of dilated vessels lined with adult endothelium. They often are present on the lips and extend over a considerable portion of the oral mucous membrane. When situated on the gums, they often give rise to recurring bleeding. Not infrequently the involved regions are enlarged to a varying extent because of the presence of an associated cavernous hemangioma.

Cavernous hemangiomas are soft, compressible tumors consisting of large thin-walled sinuses with a limited quantity of intervening stroma. They often occur in adults as small varix-like enlargements on the vermilion border of the lips or in the oral mucous membrane (Fig. 1). These may be due to trauma. Those of congenital origin may form a huge vascular mass which produces diffuse enlargement and distortion of the involved parts. Those of smaller size usually are asymptomatic but the larger growths may loosen the teeth and interfere with mastication. They also may give rise to severe hemorrhage. Trauma from the teeth at times induces active bleeding and also recurring infection. Reder[1] reported alarming hemorrhage from an angioma of the cheek because the patient bit the growth. Fatal hemorrhage following dental extraction in cases of hemangioma of the mouth has been recorded by Broderick and Round[2] and by Kroh.[3] In the latter's case the hemangioma involved the mandible and its presence apparently had not been recognized prior to the extraction. When tumors of this type about the mouth extend up over the frontal and temporal region, severe persistent pain may be complained of in these regions. This complaint is more likely to be made when phleboliths are present in the tumor than under other circumstances.

Macrocheilia and macroglossia at times result from these vascular tumors (Fig. 2*a* and *b*). The tongue of a man 50 years of age seen a few years ago was so greatly enlarged and elongated that it readily

protruded below the point of the chin and rendered it difficult for the patient to close his mouth. During the periods of acute inflammatory reaction in the tongue, which recurred at frequent intervals, complete closure of the mouth was impossible. Not only were the functions of speech and deglutition interfered with but the patient's rest was disturbed seriously. This disturbance of rest resulted from the fact that whenever he dropped off to sleep the tongue became excessively engorged and protruded from the mouth much like a phallic erection.

Plexiform or racemose hemangiomas, also known as cirsoid aneurysms, are closely allied to the cavernous hemangiomas but are encountered much less frequently. Actually they probably are essentially cavernous hemangiomas with single or multiple arteriovenous fistulas. They are expansile pulsating tumors which may be diffuse and of considerable extent. They can be only partially obliterated by compression and they become more tense than simple cavernous angiomas when the patient strains or the involved part is dependent. A bruit usually is audible on auscultation over the surface and a distinct thrill frequently is palpable. Because of the arterial pressure they are firmer than the simple cavernous hemangiomas and they tend to progress.

Phleboliths are commonly encountered in cavernous hemangiomas in adults. They vary from rather soft, friable, almost putty-like consistency to calcareous hardness and range in diameter from 2 or 3 mm. to more than a centimeter. In a given case they are likely to be of approximately the same size but wide variation in diameter may exist. Usually they are few in number; generally from two to six are palpable but a score or more may be present. They often produce no symptoms and universally are considered of little clinical significance. However, frequently they cause considerable discomfort, especially when present in a hemangioma overlying a bony surface which is subjected to pressure. Patients with hemangiomas of the cheek often complain of pain when they lie with the side of the face on a pillow; this is due to pressure of a phlebolith against the jaws or the malar prominence. In these situations phleboliths tend to traumatize the soft tissue sufficientiy to create a chronic inflammatory process which in turn produces persistent tenderness with some induration and more or less continuous discomfort.

Treatment.—Since the blood vessels composing the strawberry type of capillary hemangioma are lined with an infantile form of endothelium, these growths respond well to radiation and usually

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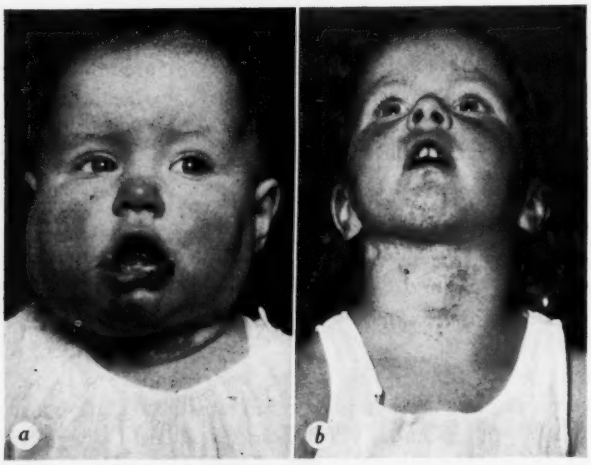
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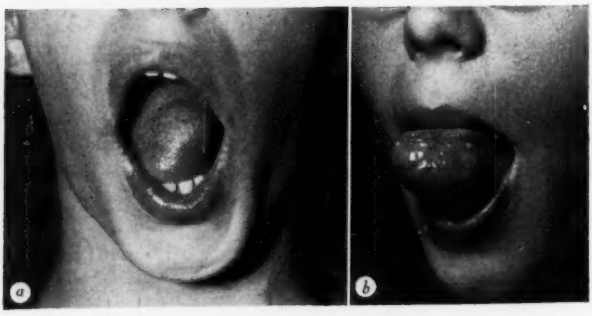
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Fig. 4.—*a*, Capillary hemangioma (port-wine stain) of the lower lip; *b*, result following plastic procedure inside the lip.

Fig. 5.—*a*, Extensive cavernous and capillary hemangioma; *b*, result following interstitial radon and radium packs.

Fig. 6.—*a*, Cavernous hemangioma of the tongue and floor of the mouth with the tongue flaccid; *b*, appearance of the lesion with the tongue protruded.

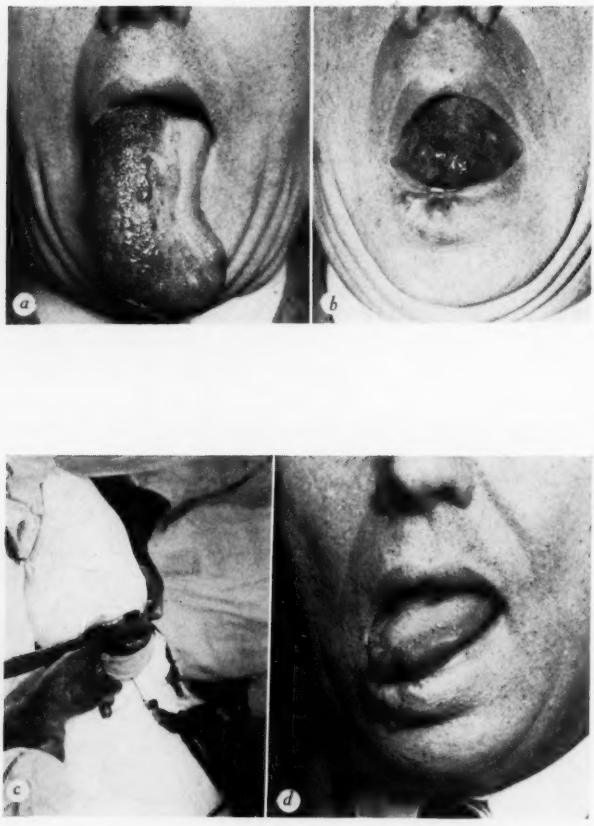

Fig. 7.—*a*, Large cavernous hemangioma of the tongue and lower lip; *b*, the tumor rendered it impossible for the patient to close the mouth; *c*, electrocoagulation of the tumor with an insulated electrode inserted through a stab wound in the submental region; *d*, result one month following electrocoagulation.

are best dealt with by means of a screened radium plaque. Cautious application of radium with the plaque moving continuously will as a rule result in complete disappearance of the hemangioma and leave little visible scarring. Some physicians prefer to treat these vascular growths by excision or by applications of carbon dioxide snow, but in our hands radiation has yielded most satisfactory results and produced a minimum of scarring.

Since port-wine stains are formed largely of blood vessels lined with a flattened adult type of endothelium, one would naturally expect little or no response to radiation and this is definitely the case. Yet in spite of this usual observation and its frequent publication in the literature, these lesions continue to be subjected to repeated applications of radium and roentgen therapy. As a result actinodermatitis with subsequent malignant degeneration is often observed in these cases (Fig. 3*a* and *b*). Less serious sequelae are unsightly depressed scars and mottling. These also may result from applications of carbon dioxide snow.

Port-wine capillary hemangiomas of the lips without associated cavernous involvement in females are best taken care of by means of cosmetics which serve to conceal them effectively when skillfully applied. Such applications are distasteful to men and if the patient is not disturbed mentally by the condition, no treatment is indicated. When the situation warrants because of undue self-consciousness, unsightly scarring from previous treatment or actinodermatitis, excision with application of a skin graft is the treatment of choice. Inside the mouth these lesions obviously are of no consequence and treatment is not necessary. When a nevus flammeus of the lip is associated with a cavernous hemangioma which is producing deforming enlargement, the latter lesion should be controlled by electrocoagulation or by injection of a sclerosing solution before excision and plastic replacement of the involved surface is undertaken (Fig. 4*a* and *b*).

Cavernous hemangiomas of the lips and mouth in infants and children are best treated with radiation. Radon seeds of from 0.25 to 0.3 mc. each, implanted into the tumor and spaced approximately 1 cm. apart usually produce satisfactory reduction with a minimum of deleterious effects. Such treatment can be repeated in from four to six months if indicated. While roentgen therapy or radium packs will sclerose these cavernous lesions if applied repeatedly, their use is indicated in only the diffuse lesions of this type and in these they are applied to supplement interstitial radiation (Fig. 5*a* and *b*).

Fig. 8.—*a*, Extensive, diffuse plexiform hemangioma of the mouth, face and scalp with the patient in repose; *b*, portion of the hemangioma involving the mouth; *c*, same patient straining; *d*, result following use of intensive electrocoagulation several times. Note that the facial nerve is intact. At the time this photograph was taken straining or holding the head down produced little change in the patient's appearance.

Repeated external therapy is likely to produce pigmentation, telangiectasis and sclerosis in the overlying skin which may interfere with subsequent development of the soft tissues and bony structures. Such unfortunate results are now being observed in some of the patients treated years ago by this method.

Cavernous hemangiomas of the cheeks and lips may be treated with injections of boiling water according to the method of Wyeth.[4] However, some of the other sclerosing agents notably 5% solution of sodium morrhuate appear to be equally effective, are more easily handled and involve less risk of slough. During the injection of the sclerosing solution peripheral pressure should be maintained in order to prevent too rapid diffusion of the agent and to lessen the possibility of embolism. Maintaining the pressure for some hours following the injection has appeared also to increase the efficacy of this type of treatment. About the mouth and face, injection of a sclerosing solution frequently is ineffective because of the impossibility of localizing the solution for a sufficient period of time. The injection of boiling water and other sclerosing agents into the tongue bears the possibility of sepsis and of producing excessive local reaction with edema which may spread to the larynx and induce respiratory obstruction. I feared that tracheotomy would be necessary after injection of boiling water in one of my cases and it was required within a few hours after such an injection in one of Reder's cases.

Because of its better localization and greater effectiveness cavernous hemangiomas of the lips, cheeks, tongue and other intra-oral structures in adults are more satisfactorily treated by means of electrocoagulation than with sclerosing agents (Fig. 6*a* and *b*). For this purpose a sharp-pointed, insulated electrode is employed and this is inserted either directly through the overlying mucous membrane into the tumor or is carried into it through a minute stab wound in the skin. When the latter approach is made, it is essential that the insulation on the shaft of the electrode be intact; otherwise leakage of the current may damage important structures and at the same time prevent sufficient coagulation of the neoplasm. More intensive coagulation of the vascular tumor is necessary than might be anticipated by the uninitiated, since the heat is diffused rapidly by the blood and carbon forming on the electrode tends to produce an effective insulator. The intensity of the coagulation should be checked by keeping a finger in the mouth directly over the tip of the electrode and also by observing the surface of the tumor during electrocoagulation. If the color of the mucous membrane changes even slightly

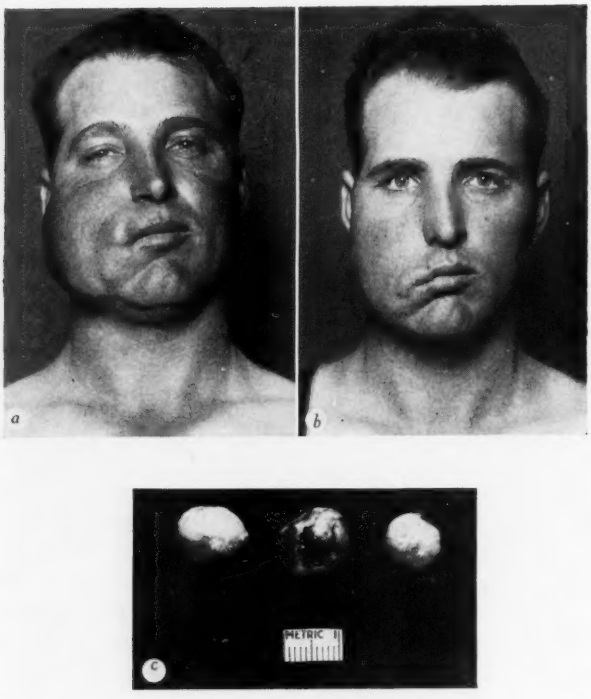

Fig. 9.—*a*, Extensive plexiform hemangioma of the mouth, lips and cheeks; *b*, result two months after a single treatment with electrocoagulation; *c*, phleboliths removed from this lesion.

from red to gray, coagulation should be stopped immediately. The margin of safety between effective electrocoagulation and that which will result in a slough is very narrow and can be determined only by experience.

As might be anticipated coagulation proceeds more rapidly when the blood is kept expressed from the tissues immediately about the electrode. Unless sloughing occurs, secondary hemorrhage is unusual in these cases. Primary bleeding from the stab wound in the skin is readily controlled by superficial coagulation as the electrode is withdrawn.

During the coagulation the electrode should be kept as far as possible from Stensen's duct, the muscles of mastication, the motor

nerves and other important structures. It is especially important that ample clearance be given the branches of the facial nerve. Spasm of the facial muscles often will occur during intensive electrocoagulation, even when the tip of the electrode is almost a centimeter from a branch of the facial nerve. This may result from direct stimulation of the muscle or from transmission of the current to the nerve by the intervening tissues. Accordingly, active contraction of the facial muscles is not necessarily an indication of impending injury to the seventh nerve.

On a number of occasions I have inserted an insulated electrode through a small stab wound in the submental or anterior part of the submaxillary region for treating large cavernous hemangiomas of the tongue and floor of the mouth (Fig. 7*a*, *b*, *c* and *d*). This procedure obviates direct contamination of the coagulated region and, if care is taken to avoid burning through the oral mucosa, the operative wound remains clean, there is little likelihood of secondary bleeding and convalescence is materially shortened. This method has proved most effective in shrinking down some of these lesions that had not responded to radiation or to injection of sclerosing agents.

Plexiform or racemose hemangiomas are more difficult to obliterate than simple cavernous angiomas because of the increased pressure within the component blood vessels resulting from the arteriovenous communications (Fig. 8*a*, *b*, *c* and *d*). The force of the impulse presented by these tumors is directly dependent on the size of the fistulous openings and is a factor in determining the type of treatment indicated. These lesions are encountered most often in adults but they may occur in infants. When they are seen early in life, interstitial radiation may control them but ligation of the afferent vessels frequently is also necessary. In adults lesions of this type with only a slight impulse often can be shrunk by means of electrocoagulation, while radiation or injection of sclerosing agents alone is not likely to be of benefit. If the lesion is not too extensive, excision may be feasible and at times is the most effective means of control. This frequently is the case also when the expansile force is pronounced. Because of the free collateral circulation, ligation of the external carotid artery usually is less effective than tying off the afferent vessels directly about the periphery of the tumor. In an occasional case the mass will become flaccid immediately after ligation of a single large vessel at its border and electrocoagulation or the injection of boiling water or of a chemical sclerosing agent then will readily bring it under control.

In cases in which phleboliths in hemangiomas about the jaws cause discomfort removal of the offending phleboliths is indicated (Fig. *9a, b,* and *c*). Usually these vein stones are readily palpable and they may be removed with surprisingly little bleeding. Removal is accomplished by holding the stone firmly against the bone or against a finger placed inside the mouth with the soft tissues drawn tightly over it. The skin is then incised and the soft tissues spread with sharp-pointed scissors until the phlebolith is exposed. In this manner the offending concretion can be expressed through a small opening.

SUMMARY

The various forms of hemangiomas occurring about the lips and mouth are reviewed, and the treatment of these different lesions and of the phleboliths at times encountered in cavernous angiomas is discussed. In general, radiation is the treatment of choice for strawberry birthmarks and cavernous hemangiomas in infants and small children. In adults cavernous lesions are more effectively treated with electrocoagulation and injections of boiling water or chemical sclerosing agents. Well-circumscribed hemangiomas often are best excised. Plexiform or racemose hemangiomas usually require ligation of the afferent vessels in addition to the measures employed in treatment of cavernous hemangiomas.

MAYO CLINIC.

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LXIX

PRESENT-DAY CONCEPTS ON THE TREATMENT OF ESOPHAGEAL PERFORATIONS

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Before the advent of penicillin, streptomycin and the sulfonamide drugs, the treatment of esophageal perforations was not uniformly agreed upon. There were two opposing schools of thought, but with the coming of penicillin one would imagine that the two schools would have become one. This was not the case, and today the problem still remains undecided. However, as far as the outlook for the patient is concerned, the danger from being handled by the more conservative methods is no longer as great a threat as it was in the days preceding antibiotics.

At present (as in the pre-penicillin days), there exists one school of thought, the interventionists, who urge that cervical mediastinotomy be performed as soon as the diagnosis of esophageal perforation is made or even suspected, notwithstanding the penicillin being administered. On the other hand, we now have a conservative group who think somewhat differently, but from a surgical standpoint essentially the same as the conservative group of non-interventionists of old, who would rather wait and see if complications such as mediastinitis occur before they advise surgery; that is, if they would advise it at all.

The essential difference between this group of conservatives and their older counterparts is that the present group have penicillin and other chemotherapeutic agents which they can administer to the patient during the "waiting period." This is a decided improvement over the period before antibiotics when watchful waiting was practiced during this most critical phase in the pathogenetic process

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and only prayers could be offered for the patient if a fulminant mediastinitis developed, since surgery at this late stage was doomed to failure as the result of septicemia or other fatal complications.

The purpose of this communication is to review briefly the older concepts and also to describe the more modern schools of thought on the subject of the treatment of esophageal perforations. Case histories will be presented in moderate detail to show how important a part penicillin plays in the treatment of this disease provided that we fully understand the limitations of its usefulness. We will attempt to show that penicillin certainly is most useful and necessary in the treatment of esophageal perforations, especially during the immediate period of watchful waiting following the trauma to the esophagus. We shall further try to demonstrate that penicillin has not by any means obviated the necessity of surgical intervention in the treatment of this disease, especially when complications such as mediastinitis, pleural effusion, or empyema have occurred.

There is no doubt that penicillin alone, or abetted by occasional pleural aspirations with instillations of penicillin and streptomycin, has achieved cures in many instances. Certainly, the results are a tremendous improvement upon those of the old conservative school whose watchful waiting meant that little more could be offered (once a mediastinitis developed) and led in 87 per cent of cases to a fatal termination.

There is no disagreement with regard to the usefulness of penicillin in the treatment of this condition. We are one of its most enthusiastic proponents. Our arguments are not to decry its use but to emphasize the necessity of using this drug with proper perspective. Would it not be more feasible to consider how much more useful it would be to associate our chemotherapeutic measures with immediate prophylactic cervicotomy to wipe out the 27 per cent death rate which previously existed when early cervicotomy alone was performed, rather than to associate the use of this drug exclusively with the "watchful waiting" technique from which an 87 per cent death rate was formerly reported?

Pearse[1] analyzed 64 records of patients with esophageal tears from one cause or another. Thirty-three of these patients were operated on early. Of these, 24 survived and 9 died. In other words, in spite of early cervical mediastinotomy in the pre-penicillin era, there was still a 27 per cent fatality rate to contend with. But even more interesting is the fact that in the 31 patients on whom no operation at all was attempted and for whom watchful waiting

alone was done, 27 of these 31 patients died and only 4 lived—an 87 per cent mortality. These figures, we feel, closely parallel those of Phillips[2] who reported in the days before antibiotics on 11 patients treated by cervicotomy immediately upon diagnosis. In spite of this early, almost prophylactic cervicotomy he still had to report the loss of three patients in this group. On the other hand, Orton[3] in 1930 reported on 6 patients with a foreign body in the esophagus who developed perforations and were treated by conservative measures. Five of these 6 died within a few days. Recently, in a personal communication to one of us (A.A.G.), he stated that this approach was inadequate and that early surgery was indicated.

In reviewing the literature, it was interesting to note the gradual development of the therapy for esophageal perforations. Incision and drainage of the cervical area was carried out as far back as 1895 and even before then. This phase is not a new one but there are certain milestones that stand out with regard to the therapeutic development. In 1916, Marschik[4] from Hajek's Clinic described the technic of cervical mediastinotomy by incision anterior to the sternomastoid muscle. His description of this procedure served as a basis for most operations of cervicotomy since that time. He was possibly one of the first to advocate prophylactic mediastinotomy in all cases of threatened mediastinitis with sealing off and draining of the cervical mediastinum, depending on the findings at operation.

In the same year, Guadiani[5] modified the above approach by adding a second step. He advised that a posterior mediastinotomy be carried out at the same time or later, if and when the infection should spread to the posterior mediastinum below the level of the fourth thoracic vertebra.

Lederer[6] in 1934 reiterated this approach. Furthermore, he brought to light the controversy that existed at that time between those of the conservative school and those of the "surgery early" school. The following is a quotation from his paper:

> "There should be no doubt in the minds of competent surgeons that confined nonspecific infections, no matter where they may be, must eventually be connected directly with the outer surface of the body. Whether or not one surgeon decides to wait ten days for the formation of a pyogenic membrane, while another prefers a delay of fourteen days, depends entirely on individual experience. Furthermore, the history of a case, correlated with a complete survey of the patient's status, permits sufficient elasticity in judgment to provide interesting material for debate between consultants. The verdict is sometimes rather unfortunate for the younger surgeon, who usually cannot afford to procrastinate and often appears as an alarmist, whereas the older consultant, if he desires to be contrary, may advise waiting, only to perform the operation finally himself.

"Our obvious duty is to emphasize the uncertainty accompanying that period following known perforation of the esophagus, either before or during the removal of the foreign body. The problem resolves itself, then, into the advisability of prophylactic mediastinotomy (cervicotomy)."

In spite of the better results reported by the interventionists up to the time when penicillin was first used in the treatment of this condition, there were still a number of conservative die-hards who questioned the value of early cervicotomy. They maintained that they would rather wait until the infected area had become walled-off than to perform an early cervicotomy. Their usual approach was to have the patient undergo a gastrostomy for feeding until such time as the process would become walled-off, thereby permitting a thoracic surgeon to operate whenever the pus accumulated. Of course, the weakness of this approach was how was anyone to know beforehand which esophageal tears were going to become walled-off and which patients were going to develop fatal mediastinitis; the surgeon meanwhile sat on the fence and offered nothing to prevent this most fatal development.

It might be of interest to mention at this point a third form of therapeutic approach. Kramer[7] in 1929 postulated that attempts should be made to drain the ensuing abscess through the tear by esophagoscopic aspirations under direct vision. He mentioned some cures, not many, that were accomplished in this fashion. This method, in our eyes, seems to leave a good deal to be desired since complete and adequate drainage by this technique is provided with difficulty. Furthermore, it is again almost impossible to know which infection will localize and drain itself through and into the esophagus, and which, on the other hand, will become a spreading, fulminating and fatal one.

To summarize the attitudes in existence in the days before penicillin we offer the following thoughts of two authorities:

Neuhof[8] analyzed 66 cases of mediastinitis. Fifty per cent of these patients developed this condition secondary to instrumentation or foreign body penetration of the cervical or thoracic esophagus. He felt that early external operation with exposure of the tear and drainage to that area was urgently needed regardless of site. He emphasized the inability to control the spread of infection once it developed in the mediastinum following trauma to the esophagus. Furthermore, the high mortality rate well known to the surgeon of old should lead to the decision to operate early in all cases. This decision is compatible with the fact that the patient might even be symptom free at the time.

Churchill[9] emphasized that perforations of the esophagus by foreign bodies or as a result of instrumentation are as urgent a surgical emergency as a perforated abdominal viscus. He was for immediate operation and stressed that the flora of the lumen of the esophagus is as virulent as that of the colon. He advised and urged that surgeons not wait until the infection walled-off or until x-ray evidence of mediastinitis developed.

With the advent of penicillin, the pendulum has swung heavily to the side of the non-interventionists who have obtained a number of cures by using massive doses of penicillin in conjunction with other previously tried and accepted conservative therapeutic measures. When the diagnosis of esophageal perforation is made (or even suspected), the following course of management is at once recommended:

1. One hundred thousand units of penicillin is instilled intramuscularly every two hours (50,000 units per cc.).

2. Nothing is given by mouth. Intravenous therapy may be instituted for feeding purposes. Years ago, if the illness was expected to be long-drawn out, then gastrostomy was usually performed. However, Levine feeding tubes have been used with good results, although not without danger since cases of perichondritis of the cricoid cartilage have been reported from our clinic following prolonged use of these tubes.

3. The patient is placed in the Trendelenburg position, especially if the perforation is high, to prevent secretions from trickling down to the esophagus with resulting contamination of the involved area.

4. One hundred per cent oxygen is administered continuously by mask to help combat cyanosis, dyspnea and restlessness. Oxygen is also of value in the active treatment of anaerobic organisms which might be present. Furthermore if the resulting emphysema has a high oxygen content (preferably 100%), it usually will be absorbed more quickly.

5. Sedation in the form of demerol (50 mg.) may be used every four hours if necessary but should be given with caution since nothing should be done which might depress the respiratory center.

6. Inasmuch as spirilla and fusiform bacilli are associated in cultures along with anaerobic bacilli to a great extent, it is important to carry out anaerobic as well as aerobic bacteriological investigations.

It is suggested that hydrogen peroxide mouth sprays be used routinely to help combat anaerobic organisms that may exist in the mouth and throat of the patient. Iron and arsenic cacodylate (gr. 1) administered intravenously daily for seven days and longer if necessary are also of value depending upon the clinical status of the patient. Furthermore, polyvalent anti-gas gangrene serum certainly should be administered prophylactically along with tetanus anti-toxin. Fortunately, penicillin plays a major part in tetanus and gas gangrene infections as well as in the treatment of spirilla and fusiform bacilli infections, so that the "anti-gas" and anti-tetanus measures lose some of their previous importance and can today be even omitted (although this is not advised) without jeopardy to the patient.

7. Small and repeated blood transfusions are of value. Frequent red blood cell and hemoglobin determinations will help to indicate when there is need for this therapy.

8. Sulfadiazine and streptomycin should be started as early as possible. Sodium sulfadiazine, gm. 3 to begin with and then gm. 1 given every four hours intravenously is a good therapeutic measure. A word of caution is offered here. If the sulfonamides are used, white blood counts must be carried out daily. If the count falls below the arbitrary figure of 5,000, then this procedure should be discontinued. An adequate fluid intake and output must be assured or the drug should be discontinued. This is especially true if the output for 24 hours be less than 1000 cc. Finally, many patients cannot tolerate the sulfonamide drugs and not infrequently they are sensitive to them. As a result one feels inclined to discontinue this drug at the slightest adverse indication, for example, skin rash, vomiting and hematuria. It might be added here that no unusual dependence is placed on sulfonamide or penicillin blood levels. We are guided chiefly by the clinical progress of the patient and by the development of any of the aforementioned adverse reactions.

On the other hand, streptomycin can usually do all that the sulfonamides are capable of accomplishing with much less serious side effect. The method of choice seems to be to give the patient 0.25 grams every four hours daily by the intramuscular route. A course for five to six days or longer is administered, depending on the clinical response of the patient as well as on the presence or absence of toxic manifestations. In this instance, severe vertigo and ringing in the ears seems to be a common complaint if the drug is given over a prolonged period of time. In some patients, an actual loss or severe depression in hearing may result, but for fulminating infections such

as acute mediastinitis or in the early treatment of esophageal perforation, streptomycin seems to be indicated in spite of its possible side effects. However, if one desires to combat the adverse side effects of streptomycin (especially vertigo), the simultaneous administration of pyribenzamine (50 mg. twice daily, preferably at bedtime and after breakfast) may be of value.

In so far as penicillin is concerned, it is ideal. The only factor against its use would be that the organism is penicillin resistant. It can be administered in tremendous dosage with little to no side reactions. What side effects do occur are usually benign and they are not, in most instances, contraindications to continued treatment. The urticarial effects, rarely developing, usually can be overcome with the employment of pyribenzamine or anthallan, or one of the newer antihistaminic drugs. Furthermore, penicillin can be given by all routes, including the less effective oral route, not indicated under these circumstances. For fulminating infection such as we are concerned with here, the intramuscular route by way of the deltoid, the vasti or the glutei muscles seems to be the best.

One note of warning may be here given with regard to the increasingly frequent use of 0.5% procaine as a local anesthetic agent in conjunction with the intramuscular employment of penicillin in order to alleviate the pain associated with the injection. Procaine can be used. It will not interfere with the action of penicillin; but investigations in World War II, in which Novotox (a trade marked product containing novocaine) was used revealed that penicillin was destroyed to a great extent by this solution and as a result this procedure was looked upon with disfavor. This is especially true since the action of Novotox and procaine are similar and to some untrained individuals may come to mean one and the same thing in that they are both local anesthetic agents. It is emphasized that it be clearly understood that procaine certainly can be employed, but that Novotox, on the other hand, must not be used in conjunction with penicillin. In this connection, it might be mentioned that procaine as well is no longer an important adjunct today since it was chiefly the impurities in the earlier penicillin preparations that appeared to be the causative agent in the development of pain on administration, so much so that in the past many investigators used local freezing of the area over the deltoid, which served to minimize the painful reactions as well as to prolong the absorption of penicillin from the site of injection. Today in so far as the pain is concerned, with the advent of the more purified crystalline brands of penicillin, one wonders if procaine would be of any need or value at all since

it will not at best remove the sensation of the "needle prick" as the needle plunges through the skin.

To continue with other therapeutic measures, one must emphasize that the patient may have come for investigation of certain complaints referable to the esophagus or elsewhere. The treatment for the original condition must be maintained, as for example, the patient who has had dysphagia and in whom a neoplastic lesion was suspected.

Thoracic surgeons should be consulted as soon as a diagnosis of perforation is suspected and usually should remain keenly observant for any possible condition that might require surgical intervention in the mediastinal area. This brings us to what we feel is the crux of the entire consideration and that is: when is surgical intervention indicated?

Presently, the trend has been toward conservative action now that penicillin and other chemotherapeutic and antibiotic agents are employed, and this with good reason, but that is a far cry from feeling that surgery is now a thing of the past. There is no doubt, as we inferred before, that now the conservative attitude of watchful waiting with the use of the aforementioned agents, is certainly a tremendous improvement over conservative measures of the pre-penicillin days and certainly is not as prominently associated with the danger of an 87 per cent fatal termination. This does not detract from the fact that an operation is still decidedly indicated in many cases. Above all, since cervicotomy (as carried out today under local anesthesia) is a simple procedure and by no means a dangerous one in competent hands, we believe that in all cases of high esophageal perforations, notwithstanding the splendid results obtained in many instances by the so-called conservative measures alone, a prophylactic cervicotomy should be performed as soon as the nature of the condition is suspected. Other measures as brought out in this discussion must be employed simultaneously.

Following the generalized adoption of the present-day attitude in favor of conservativeness plus penicillin in the treatment of any one patient, are we correct in assuming that under these circumstances surgery is unnecessary at any time? The answer is most certainly in the negative. Surgery can still be of great value in the later phases of this condition. Under these circumstances the controversy would hinge on the element of time. When should surgical intervention be invited by the conservative otolaryngologist if he had originally decided to try nonsurgical measures and the patient

was not responding? If this question can be logically resolved then we can feel secure that the problem of the treatment of esophageal perforations has come as close to a solution as it is humanly possible. We feel content that this question can be answered along the following lines of early conservative therapeutic approach; namely, as soon as a perforation is suspected and along with the employment of therapeutic measures, a series of "indicators" be set up at once. When these indicators are established, they have to be serially repeated at frequent intervals, some four times daily, others every two hours.

With the aid of these indicators, the problem as to when to operate becomes far less confusing than formerly. This in itself brings the two schools of thought together in a logical and practical manner, if our previous suggestion of prophylactic cervicotomy be overlooked or treated lightly. All this, of course, adds up to better care for the patient with less danger to life. The indicators for mediastinotomy are as follows:

1. A history of known esophageal trauma. This is included here since the history alone in a suspicious situation should be enough to have treatment begun.
2. X-ray evidence of air in the tissues.
3. Clinical symptoms and signs of prevertebral or mediastinal emphysema.
4. The course of the white blood count, the pulse and the temperature.

Firstly, as soon as the treatment has been started, x-ray films must be taken of the neck and chest in the postero-anterior or antero-posterior and lateral views. These should be repeated daily or more often, depending upon the clinical progress.

Secondly, temperature, pulse, respirations and white blood counts should all be carried out every two hours and, if possible every hour for the first eight hours at least, and then four times daily. Most important is the fact that a frequent evaluation of the clinical status should be checked every four to six hours if possible, but certainly no less often than twice a day to estimate if conservative therapeutic measures alone are sufficient. This can be determined by a serial study of all the indicators. If the pulse, temperature, respirations and white blood count reveal no progression or are returning to normal, then expectant treatment can be continued provided that these findings are consistent with improvement in the x-ray findings and the clinical status of the patient. If not, the history of a known

Fig. 1, Case 1.—*A*. Six hour postoperative lateral roentgenogram of the neck revealing emphysema and a suggestion of widening of the prevertebral space. *B*. Film in similar position taken three days later displaying further infiltration and widening of the prevertebral area. Most of the air as previously noted has been absorbed. *C*. Subsequent study of the neck filmed four days after *A* indicating further increase in the width of the prevertebral space. Cervicotomy was performed shortly after this film was taken.

trauma and the x-ray findings and the clinical condition supersede all other findings in importance with regard to whether or not surgery is indicated. If roentgenographic evidence and clinical findings plus some or all of our other previously established indicators should show progression of the disease process—then immediate surgery should be carried out in the area indicated. Furthermore, under these conditions, if it be a high esophageal perforation alone, then a cervicotomy must be performed at once. Following this procedure all indicators are still to be maintained and now, especially if the chest film shows progression of the lesion, chest aspiration with instillation of penicillin or streptomycin is indicated.

If, in spite of this, the lesion progresses, as evidenced by an increase in the volume of pleural effusion as determined clinically or by x-ray study, then posterior mediastinotomy is the immediate and urgent treatment of choice. In fact, it is still debatable whether or not it might be more judicious to perform a thoracotomy before even trying to treat the pleural effusion by aspiration. Cures have been reported by this method alone and thus its merit is not to be questioned unfairly.

REPORT OF CASES

CASE 1.—G. E., a 58-year-old white female, was referred from Medical Service for a diagnostic esophagoscopy. Her symptoms were referable to her lower esophagus. She was given premedication in the routine fashion and underwent esophagoscopy on May 6, 1947. The procedure was described as a difficult entry through the cricopharyngeal area but there was no evidence of trauma at the time.

Two and a half hours later (after the effects of the anesthesia and premedication had worn off), she complained of a severe pain in her back localized at the area of the third and fourth dorsal vertebrae. Associated with this severe pain was great difficulty in breathing deeply. She became quite restless.

Physical examination revealed some evidence of cyanosis. The patient appeared quite anxious and was dyspneic. Her main complaint was a severe, constant pain in her back which was made worse on slight movement. Some tenderness was noted over the area of her sixth cervical vertebra anteriorly on the left side. The soft tissues of the neck seemed to be filled out and felt somewhat doughy, but no crepitus could be elicited at that time (1:45 p.m., May 6, 1947).

The following measures were immediately initiated: nothing by mouth, 100% oxygen continuously, intravenous fluids 2500 cc. with

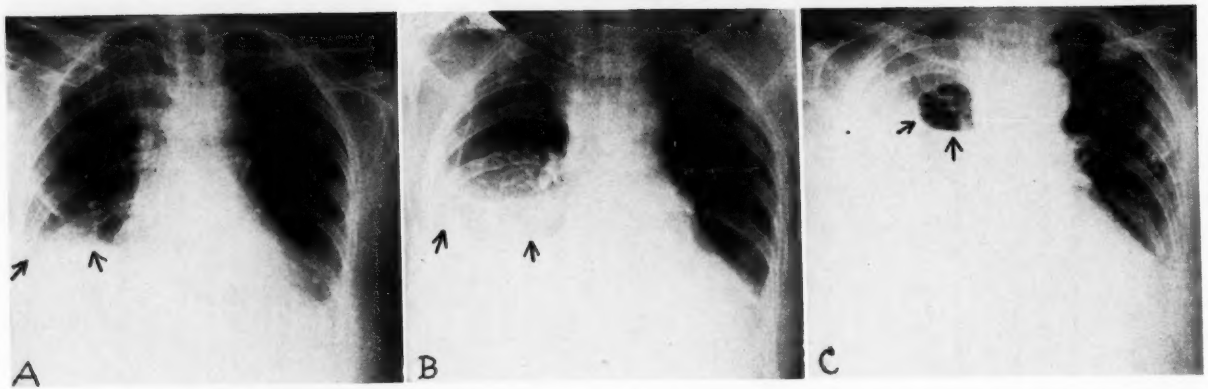

Fig. 2, Case 1.—*A*. Postero-anterior view of the chest taken four hours after esophageal injury. An elevation of right diaphragm with suggestion of fluid in right base is particularly noted. *B*. Roentgenographic study taken approximately two days later revealing the presence of fluid at the right base (pleural aspiration at this time was productive of only 5 cc. of straw-colored fluid). *C*. Chest film taken four days after injury revealing an extensive volume of fluid in the right chest with a characteristic "fluid level." The heart is pushed over to the left. Note encapsulated extrapleural air pocket resulting from frequent attempts at aspiration.

soluble vitamin B (Betalin) and cevitamic acid daily. The Trendelenburg position was recommended and attempted, but the patient was not comfortable and actually became more restless in this position. As a result she was put up in the orthopneic position which she seemed to prefer. Penicillin was immediately started, 100,000 units were administered intramuscularly every two hours. At the same time 3 grams of sulfadiazine were given intravenously followed by 1 gram every four hours.

The following indicators were sought almost immediately and the serial results were as follows:

a. A chest roentgenogram was taken at three o'clock on the same day. This revealed an elevation of the right diaphragm with some questionable fluid in the right base (Fig. 2*A*), the raised diaphragm suggested the possibility of some phrenic nerve irritation. X-ray films of the neck were then taken and they revealed the presence of air in the prevertebral space over the area of the fifth and sixth cervical vertebrae (Fig. 1*A*). This column of air extended up to the base of the skull. Chest films were repeated later that day and were indeed more suggestive of fluid being present in the right base.

b. At approximately 2:30 p. m. the white blood count was 12,000. This count was repeated at 7:00 p. m. and remained at a level of 12,400. The red blood count was 3.9 million.

c. The temperature varied from 97.6° F. at 4:00 p. m. to 99.4° at midnight.

d. The pulse at 8:00 a. m. on the morning of the esophagoscopy was 80. By four o'clock that afternoon it rose to 112 and at midnight was up to 120. This indicator seemed to be the first to reveal progression in the disease process.

e. Respirations varied from 20 to 30 per minute throughout the day.

f. Serially repeated clinical examinations of the patient with special emphasis on the neck and chest revealed crepitus for the first time at seven o'clock that evening (approximately five hours after her symptoms developed). The swelling and tenderness were now quite definite in the neck over the area of the sixth cervical vertebra on the left side. Chest examination now revealed râles on both sides posteriorly; worse over the right lower lobe. No crepitus was elicited over the precordial area.

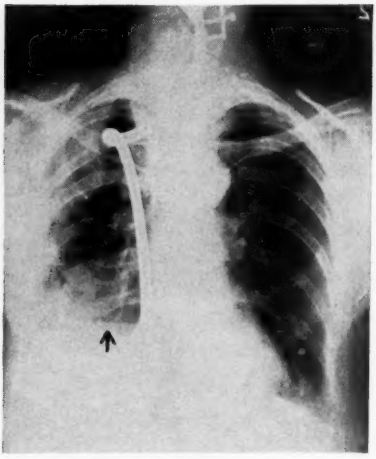

Fig. 3, Case 1.—X-ray study taken a few days after cervicotomy and thoracotomy had been performed, revealing marked improvement. Note the increase in lung expansion as well as the rubber tube drain. The heart shadow is returning to its normal position.

On May 7, 1947, all the indicators mentioned above were repeated in similar fashion with the following results:

a. The lateral roentgenogram of the neck revealed no residual air within the prevertebral space. But, the antero-posterior and lateral films of the chest revealed further increase in fluid in the right base area. The chest surgeons were then consulted and in later examination suggested a chest aspiration. At 11:45 p. m. further x-ray studies were taken and still more fluid was noted in the right base.

b. The white blood count at 9:00 a. m. rose to 15,600 but by 7:00 p. m. had again dropped to 7,600.

c. The temperature throughout the second day varied from 100.6° F. to 100.8°.

d. The pulse remained consistently elevated between 120 and 140.

e. The respirations varied from 20 to 32 throughout the day.

f. Clinically, the patient seemed to be doing fairly well until shortly after nine o'clock on the evening of the second day. Up to

that moment the temperature, respirations and general condition seemed to be better than on the previous day, considering the severity of the lesion. At 10:15 p. m. the patient suddenly complained of a severe pain in her right lower chest region. She became more dyspneic and restless. The pain now became much worse, especially on taking a deep breath. Examination revealed a pleural friction rub at the right base with absent breath sounds. There no longer seemed to be any doubt that this patient had fluid at the right base with a high diaphragm (Fig. 2*B*). The chest surgeon was again consulted. It was decided that careful observation be carried out further since the temperature, white count and respirations did not reveal alarming progression.

On May 8, 1947 (the third day), the indicators were again repeated as in the previous manner and below are the findings:

a. The lateral films of the neck revealed some widening of the prevertebral space (Fig. 1*B*). The chest roentgenograms showed further increase in fluid on the right side at the level of the third rib anteriorly.

b-e. The white blood count, temperature, pulse and respirations were all elevated.

f. Clinically the patient seemed to be more dyspneic. Medical consultation was arranged for and the internists concurred with the treatment. Chest aspiration was then attempted but only 5 cc. of straw-colored fluid were removed. The laboratory reported this fluid as sterile. Further aspirations were attempted that same evening without success.

On May 9, 1947:

a. The lateral roentgenograms of the neck revealed some further widening of the prevertebral space in the lower cervical region (Fig. 1*C*). Chest films at this time again showed an increase in the amount of fluid at the right base.

b-e. The white blood count, temperature, pulse and respirations were further elevated.

f. The patient was quite restless and appeared very toxic and her complexion became sallow. Furthermore, she was very dyspneic. At this stage the treatment problem became somewhat confusing since one group strongly urged immediate cervicotomy and thoracotomy, while the second group felt that further watchful waiting was indicated. Chest aspirations were then carried out, but only

100 cc. of a straw-colored to amber fluid were removed. There was some suggestion of a mucoid element in this fluid. Three hundred thousand units of penicillin were instilled locally. The patient was started on streptomycin gm. 0.3 (given intramuscularly) every four hours. Iron and arsenic cacodylate, gr. 1 were given daily by the intravenous route for seven days.

On May 10, 1947:

a. The lateral roentgenograms of the neck revealed even further widening of the prevertebral area and films of the chest revealed once more an increase in fluid in the right base (Fig. 2*C*).

b-e. These indicators were further elevated.

f. The patient appeared toxic; she became somewhat restless and was very dyspneic. The sulfadiazine was discontinued.

At 2:30 p. m. on this, the fourth day following the esophagoscopic trauma, a left cervicotomy was performed under local anesthesia. No difficulties were encountered and the patient seemed to tolerate the procedure well. About 200 to 300 cc. of amber-colored, mucoid-like material were removed with the aid of suction. The area was packed with a rubber drain and gauze. Five hundred thousand units of penicillin were instilled into the wound locally along with sulfonamide powder. For the next few hours, the patient did not seem to be any worse but the relief certainly was not very marked. At ten o'clock on the same evening, a thoracotomy was performed. Seven hundred and fifty cc. of fluid similar in nature to the fluid obtained earlier that morning was removed from the extrapleural space. The fluid seemed to lie between the parietal pleura and the endothoracic fascia. The fifth rib was resected posteriorly in the right paravertebral area. Five hundred cc. of whole blood were administered during this procedure. In spite of the thoracotomy's allowing for direct vision into the extrapleural space, there was still some difficulty encountered in finding the fluid which was eventually discovered between the endothoracic fascia and the parietal pleura.

The remainder is anticlimatic—streptomycin was stopped on May 16 and penicillin was reduced to 30,000 units every three hours. The patient seemed to be well on her way to recovery. The cervicotomy wound healed by second intention. The chest wound was irrigated frequently with Dakin's solution. Lung expansion was being accomplished with the aid of the "2 bottle technique" (Fig. 3). The patient is alert and is now able to get up and around. The indicators are returning to normal.

CASE 2.—J. P., white male, aged 21 years, of slender stature and development, was admitted on March 21, 1947, for diagnostic study. The patient stated that he swallowed lye when he was 18 months old and an esophageal stricture developed. The stricture was dilated periodically with esophageal bougies until he was five years old. At that time a gastrostomy was required for feeding purposes and no further measures were taken to relieve the esophageal obstruction. The patient had not been able to swallow liquids since childhood and regularly expectorated retained oral-pharyngeal secretions. One month ago attempts by esophageal bouginage to introduce a silk string for retrograde esophageal dilatation were without avail.

General physical examination was normal except for a complete obstruction of the upper esophagus at the level of the arch of the aorta (Fig. 4*A*). The cervical portion of the esophagus presented, during esophagoscopy, a smooth-walled dilated sac, without an inferior orifice or even dimpling in the occluded area. The atresia was 25 cm. from the upper teeth. Under topical anesthesia several unsuccessful attempts were made to introduce a bougie into the lower esophagus through an esophagoscope placed in the region of the cardia of the stomach.

On April 15, 1947, under general anesthesia and biplane fluoroscopic guidance, the esophagoscope was introduced through the cardia of the stomach from below upwards for five or six centimeters above the level of the diaphragm. Another esophagoscope was introduced into the pharynx and cervical esophagus to visualize the atretic membrane. Following proper alignment of the esophagoscopes, a Barretto needle with silk string attached was passed into the lower esophagoscope through the atretic membrane and into the esophagoscope in the cervical esophagus. The silk string was adjusted through the nose and stomach as a continuous circuit for future retrograde esophageal dilatations. The retrograde esophagoscopy was accomplished with moderate resistance in the region of the cardia and the lower esophagus. There was always the possibility of following a false passageway of a previous bouginage in the lower esophagus.

In order to recognize the onset of a clinical complication and not alter or disguise its presence, all antibiotics and chemotherapeutic drugs were withheld pending further postoperative observation. Thirty-six hours later the patient complained of constant chest pain in the midthoracic area with difficulty in breathing. Deep inspiration aggravated the degree of chest pain. The temperature was

Fig. 4, Case 2.—*A*. Esophagram showing complete esophageal obstruction above the level of the arch of the aorta. *B*. Antero-posterior view of the chest, 12 hours after clinical signs of esophageal perforation developed, showing infectious process at right cardiophrenic angle and elevation of right diaphragm. *C*. Postero-anterior view of the chest, five days after esophageal perforation, showing resolution of mediastinitis.

99.4° F. and the respiratory rate, 24 per minute. On physical examination the chest expansion was equal; there was no evidence of cyanosis or subcutaneous emphysema. Auscultation did not elicit any râles, mediastinal crepitation or crunch. There was questionable dullness to percussion in the posterior chest at the vertebral angle. Abdominal examination did not reveal definite rigidity or tenderness.

A tentative diagnosis of mediastinitis was made and therapy instituted. The patient was placed in the Trendelenburg position and 100% oxygen administered by face mask. Gastric feedings were omitted and fluids given intravenously. Penicillin was prescribed in a dose of 100,000 units every two hours, intramuscularly. Temperature, pulse and respiration were recorded hourly and frequent white blood counts taken. An x-ray film of the neck in the lateral view and chest films in the postero-anterior view and the lateral view were repeated daily. The radiologist reported that the medial portion of the right diaphragm was obliterated by increased markings extending into this region. There was no widening or haziness of the superior mediastinum (Fig. 4*B*).

The temperature went to 101° that evening (second post-operative day) and maintained a one-degree elevation for the following 36 hours. The white blood count rose from 8000 to 11,000 cells. The medical consultant concurred in the diagnosis of mediastinitis and, in consideration of the favorable progress, suggested continuation of the present therapy. The physical examination of the chest did not reveal a mediastinal crunch.

A spontaneous subjective and objective improvement occurred within three days. On the fourth post-operative day, the patient was permitted sterile water and 5% glucose via gastrostomy tube. Also the penicillin was reduced to 50,000 units every three hours. The clinical resolution of the inflammatory process in the lower mediastinum was confirmed by the report of the successive roentgen films of the chest (Fig. 4*C*). Penicillin was reduced to 20,000 units every three hours on the ninth postoperative day and discontinued on the eleventh postoperative day.

On May 3, 1947, a No. 12 and a No. 14 retrograde bougie passed through the esophageal atresia with comparative ease.

CASE 3.—A. K., white female, aged 18 years, was referred to this hospital in June 1946 because of difficulty in swallowing, with her diet limited to liquids and soft foods. In July 1945 the

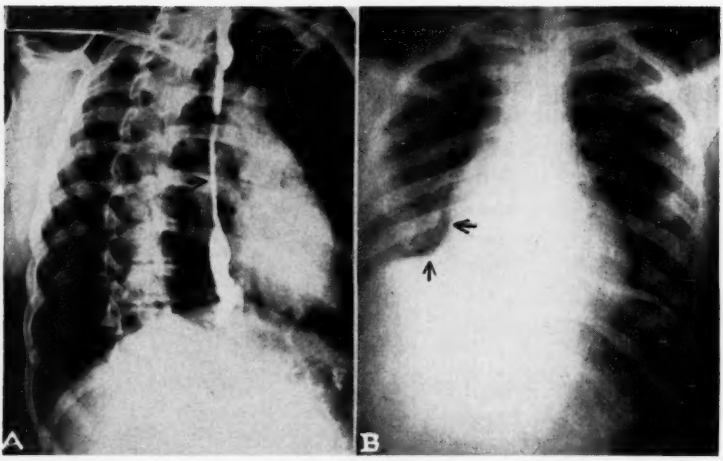

Fig. 5, Case 3.—*A.* Esophagram taken one year after the ingestion of lye showing stenosis of the cervical and thoracic esophagus. *B.* Antero-posterior view of the chest 48 hours after esophageal perforation showing widening of the superior mediastinum, diffuse haziness and mottling of markings of right lower chest and obliteration of the right cardiophrenic angle.

patient swallowed lye during a period of depression because an acute generalized skin eruption developed on her body. Emergency therapy and subsequent periodic esophageal dilatations were received at nearby hospitals. An esophagram revealed a rather uniform narrowing of the esophagus from the cricopharyngeal region for a distance of 11 cm. (Fig. 5*A*). Several unsuccessful attempts were made to pass a No. 12, a No. 14 and a No. 16 esophageal bougie through the laryngoscope, but firm resistance was encountered when entering the esophagus. In September 1946, on direct esophagoscopy, a stricture was observed 17 cm. from the upper teeth which was resistant to the passage of a No. 12 esophageal bougie. During October 1946 the patient complained of a burning sensation and discomfort in the sternal region and increasing difficulty in swallowing soft foods.

On October 22, 1946, a 6 x 30 standard esophagoscope could be passed 20 cm. from the upper teeth. At this point the stricture was very tight. A No. 10 bougie could be advanced 4 to 5 cm. beyond the tip of the scope but could not be advanced into the stomach.

Immediately following the esophageal procedure, the patient complained of constant dull pain in the chest which radiated to the back, and a sense of tightness in the chest with difficulty in breathing. The patient was admitted to the hospital for observation. The degree of chest pain increased; the breathing difficulties were aggravated; pain and rigidity in the upper abdomen and clinical signs of mediastinal and cervical emphysema ensued.

Massive doses of penicillin, 100,000 units every two hours, continuous 100% oxygen by face mask, intravenous fluids were immediately administered and routine measures, as frequent white blood counts and portable roentgen films of the chest were immediately done (Fig. 5*B*). The temperature fluctuated between 100° and 103° R. The clinical picture with increasing dyspnea and physical signs of flatness on percussion with absence of breath sounds, suggested extrapleural fluid compressing the right lung. On October 25, 1946, the third postoperative day, a retropleural needle aspiration of the right chest revealed 300 cc. of cloudy amber fluid which was sterile on culture. Penicillin, 200,000 units in 20 cc. of normal physiologic sodium chloride solution, was injected into the retropleural space before removing the aspirating needle. Sodium sulfadiazine, gm. 5, was given intravenously in Ringer's lactate solution. The clinical picture improved and the subjective complaints were relieved. The temperature curve dropped by lysis and the blood leukocytosis decreased. The penicillin, sodium sulfadiazine and oxygen therapy were continued with gradual improvement in the chest findings. The patient was afebrile after the fifth postoperative day. On October 31, 1946, a silk string was swallowed into the stomach prior to gastrostomy to be used for subsequent retrograde esophageal dilatations. A Witzel gastrostomy was performed on November 2, 1946. The patient returns for weekly retrograde esophageal dilatations and is able to swallow soft foods without any difficulty.

All the above patients were treated with penicillin; all survived. In one instance major surgery was required; in another instance pleural aspiration was necessary along with the instillation of penicillin locally, and in one case nothing more than the conservative measures alone were employed.

The following is a short discussion on a series of cases treated in the days before penicillin. It will be observed that the results in these patients were no different from those already quoted by

other authorities under similar circumstances; namely, approximately 87 per cent fatalities. In one instance perforation of the esophagus occurred during an intubation procedure for anesthesia. An improperly fitted stilette whose tip extended beyond the rubber tubing tore through the esophageal wall in the area of the cricopharyngeus muscle. In spite of an early diagnosis and in spite of a cervicotomy performed approximately eight to ten hours after the injury, this patient was dead 18 hours later.[10]

In another instance, perforation of the esophagus occurred during a one-stage diverticulectomy, wherein the esophagoscope is inserted into the diverticulum and later into the esophagus below the diverticulum. During this procedure, a tear was produced unknown to the surgeon. The patient was dead within 36 hours.

The third case occurred about 15 years ago when an esophagoscopist, in attempting to use a cotton pledget for some unknown reason on the esophageal wall, apparently produced a perforation which remained undiagnosed at the time. Twenty-four hours later this woman presented herself at the otolaryngological clinic and when the nurse approached her to lead her to the examining room she found the patient dead. The cotton pledget was recovered from the mediastinum at autopsy.

Finally, an officer in the United States Navy swallowed a chicken bone which perforated his esophagus. This occurred in September 1942. Three days after this incident the patient developed a mediastinal abscess which was treated by cervicotomy. It might be added that he was treated with sulfonamide drugs as well, but penicillin was not available at that time. Several weeks later a fistula developed in the posterior esophageal wall. The abscess was drained again and the fistula closed. This patient was fed by means of a Levine tube postoperatively. It is interesting that two weeks afterward he developed laryngeal pain and difficulty in breathing (January 1943). Obviously a perichondritis had developed which necessitated tracheotomy. When this perichondritis had subsided a direct laryngoscopic examination demonstrated web formation and stenosis in the subglottic area. The larynx was treated at regular intervals by routine dilatations and the web was incised. This patient eventually recovered. There resulted some residual impairment in phonation as well as some difficulty in breathing on exertion.[11]

This last case is interesting since this patient is the only one of the four who was not treated with penicillin who survived. It is

notable that two of the above perforations were not diagnosed at the time the lesion occurred. Both of these patients died. This emphasizes the danger of "missing" the diagnosis, since the benefits to be gained by early surgery and the immediate employment of penicillin are not possible under these cicumstances, thus exposing 87 per cent of the patients to a fatal outcome.

Before ending this discussion we might add that to better cope with this disease process, one must have an excellent knowledge of the anatomy of the neck and the mediastinum as well as a complete understanding of the early symptomatology and the signs associated with lesions in this area. Furthermore, the complications of esophageal perforations and their pathogenesis must be fully understood. All of the above have been adequately dealt with by others.[12-15] In order to obtain an early diagnosis a knowledge of the symptomatology is imperative. A few of the most common symptoms are:

1. Pain, which seems to be the earliest symptom as well as the most frequent one. Quite often it is located at the point of the perforation but not infrequently may be localized between the shoulder blades. This pain is usually severe and persistent.

2. Dysphagia, in the sense of a continuous sticking in the throat and neck. This is a less common complaint. In some instances, associated with this dysphagia, the patient may expectorate small quantities of blood.

3. Dyspnea, which is next in importance and in frequency to pain. This is usually closely associated with extreme restlessness. The patient gives the appearance of being bewildered. Part of this can readily be explained on the basis that the patient continuously tries to discover a more comfortable position. Also there usually will be frequent manipulations by those seeking to establish an early diagnosis. Furthermore, there will be repeated therapeutic measures by the intravenous and intramuscular routes. All of these procedures concentrated on a patient who only a few hours previously may have been comparatively comfortable could easily be held accountable for some of the restlessness and bewilderment. On the other hand, it is quite well agreed that the restlessness is chiefly due to the underlying condition and is often closely associated with the dyspnea, so much so that the patient speaks with frequent, short, gasping vocal efforts which are almost characteristic of the condition.

SUMMARY

1. An attempt has been made to describe the different schools of thought on the therapeutic approach to the problem of esophageal perforations in the pre-antibiotic period as well as at the present time.

2. The value of penicillin and early surgery has been emphasized along with a detailed discussion of all the therapeutic measures commonly employed in the treatment of esophageal perforations.

3. A description of the various indicators and their usefulness and interpretation has been offered in an attempt to resolve the difficulties in the approach to this problem by various observers.

4. Several illustrative cases are presented. Additional case reports are briefly discussed.

5. Early symptoms of esophageal perforations are evaluated.

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LXX

LYMPHOSARCOMA OF THE TONSIL IN A THREE-YEAR-OLD CHILD

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Lymphosarcoma of the tonsil is not common in the adult and is especially rare in a child.

There appears to be some difference of opinion in the classification of lymphoid tumors of the tonsil. According to Davis[1] some pathologists divide lymphosarcoma into two types: the lymphocytic type in which round cells predominate, and the reticular cell type in which the larger reticular cells are more in evidence and are of reticulo-endothelial origin. The two characteristics which make identification possible are: first, the round cells which appear to be larger and which have no definite arrangement as in the normal tonsil; and second, the round cells which infiltrate the deeper layers of the surface epithelium and the muscular tissue. The latter is said to be a distinguishing feature of lympho-epithelioma. However, from a clinical point of view lympho-epithelioma and reticular cell sarcoma behave in the same way as lymphosarcoma.

Mallory[2] expressed the belief that all types of lymphoblastoma (lymphocytoma, lymphoma, lymphosarcoma, lympholeukemia, Hodgkin's disease, plasmocytoma and giant lymph follicle hyperplasia) are different manifestations of one disease. The rapidity of appearance of widely scattered simultaneous metastases of sarcoma of the tonsil and the destruction of tumor masses, as is sometimes observed at autopsy, suggest a generalized disease of the lymphoid tissue or a tumor with multiple sites of origin rather than metastases from a single site of origin.

The tonsil consists of three types of tissue; squamous epithelium, reticular connective tissue and lymphocytes. Neoplasms of the tonsil are composed of cells tending to differentiate into one of the three types of normal cells. On this premise Whitcomb[3] classifies them

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Read at the Meetiing of the Chicago Laryngological and Otological Society, February 3, 1947.

as squamous cell carcinoma, transitional cell carcinoma, lymphoepithelioma, reticular cell sarcoma and lymphosarcoma. He states that in five of his seven cases the first biopsy specimen did not contain neoplastic tissue although the disease was sufficiently advanced to arouse suspicion of malignancy. Sarcoma may be only in the depth or in one area at first, which accounts for failure to discover it microscopically.

New and his associates[4] stated that squamous cell carcinoma grade IV is often called lymphosarcoma or Hodgkin's disease. Many neoplasms of the tonsil are composed of cells so lacking in signs of maturity that a differential diagnosis may be difficult. New further advises that lymphosarcoma of the tonsil may resemble simple hypertrophy but the tonsil appears swollen, often to twice normal size. It is dull reddish-pink and fleshy with rounded contour; the surface is grayish or nodular. It is not as firm as epithelioma and may be soft and cyst-like. Ulceration occurs late and fungation and bleeding are not so marked as in epithelioma. Occasionally both tonsils are involved and the condition is then to be distinguished from leukemia or from lymphatic lymphosarcomatosis. In the pharynx lymphosarcoma may appear as a distinct tumor, pedunculated and movable or as a somewhat diffuse swelling. Next to lymphosarcoma fibrosarcoma is the most common sarcoma in the pharynx. All his cases were in adults.

Sarcoma of the tonsil should be distinguished from squamous cell carcinoma of the anterior faucial pillars, the commonest malignant tumor in the region of the tonsil. Carcinoma of the pillars is slow growing and never metastasizes beyond the regional lymph nodes of the neck. It kills by pain and starvation. Sarcoma of the tonsil grows rapidly, spreads quickly and widely and kills by visceral metastases.

Davis,[1] after a study of the records of 14 cases of lymphosarcoma of the tonsil over a period of 25 years, considers three clinical types: The commonest type is a sudden and rapid enlargement of one tonsil with an equally rapid enlargement of corresponding lymphatic glands in the neck. The tonsil is soft, friable, bleeds freely; the capsule is almost absent and for this reason enucleation is difficult. The second type resembles severe Vincent's angina when first seen. Ulceration is at first superficial and confined to the tonsil area; later it becomes deep and extends to surrounding structures. The third type is one in which a mass of enlarged glands is found in the neck. Later a focus in the tonsil or the nasopharynx becomes evident.

All his cases of lymphosarcoma of the tonsil were in adults and all died within 18 months from onset of symptoms.

Lymphosarcoma of the tonsil in a child is sufficiently rare to warrant the recording of a single case. Only a few such cases were found reported in the literature.

Cline[5] in 1911 reported a case in a 22-month-old child. There was a history of a tonsillar abscess two months previously and at the time of examination the child was dyspneic. He found a nodular growth involving the left tonsil and almost filling the pharynx. It was soft to touch and bled profusely on pressure. Several large lymph nodes were palpable under the angle of the jaw. The biopsy report was lymphosarcoma. He removed most of the involved tonsil but within 12 days the tumor enlarged rapidly in all directions and death occurred two weeks later. In conclusion he states he had never seen or heard of sarcoma of the tonsil occurring at so young an age.

In 1931 Chappell[6] in his report of a case in a seven-year-old male comments that this case is of particular interest from a clinical standpoint on account of the age of the patient. Examining case reports of sarcoma of the throat for the past ten years he did not find a case in a person who approximated this patient in age. In the left tonsillar fossa was a mass the size of a golf ball, purplish colored, firm on palpation, which bled easily and resembled a peritonsillar abscess but aspiration revealed no pus. He performed a tonsillectomy. The laboratory report suggested malignant possibilities. The child was readmitted three weeks later at which time an extensive cauliflower mass was found in the left tonsillar fossa. A biopsy at this time disclosed lymphosarcoma. No metastases were found in the chest. Roentgen therapy was instituted but the mass continued to extend in all directions and the patient expired two weeks later.

Daufman[7] records in his textbook a case of lymphosarcoma the size of a plum in the throat of a boy five years old. Details of the clinical history and findings are lacking.

Lopez[8] reported a lymphosarcoma of the right tonsil in a three-year-old boy. The tumor was soft and friable. Two extirpations of the tumor, plus roentgen therapy, failed to check its regrowth and extension. A tracheotomy became imminent with death ensuing shortly after.

REPORT OF A CASE

V. G., a white boy three years old, was referred by his pediatrician on account of a rapidly progressive enlargement of the left tonsil in the last month. There was no pain or fever but increasing respiratory

effort. The left cervical lymph glands had become slightly enlarged but were not tender. The child now had a recurrent attack of nasal blockage with secretions, suggesting a nasal allergy. The mother had autumnal hay fever. Examination of the child on August 9, 1945, revealed the nose filled with mucoid secretions, slightly enlarged non-tender left cervical lymph nodes, and an unusually large left tonsil almost closing the nasopharynx. The tonsil had a smooth surface, was uniform in outline, and on palpation was soft in consistency and did not bleed. The lips were dry because of mouth-breathing. The child displayed inspiratory difficulty on lying down. A ragweed skin test was negative. After suction the nasal tissues appeared edematous and pale.

A complicated problem presented itself. Tonsil surgery was not permitted because there was a poliomyelitis epidemic prevalent at the time, the child had a nasal allergy with a family history of hay fever and the hay fever season was just approaching. In view of the facts that respiratory difficulty was increasing, a roentgen therapy response would be too slow, and a biopsy was essential not only for differential tissue diagnosis but also for adequate treatment, special permission was obtained from the hospital to allow a minimal general anesthesia for a rapid removal of the involved tonsil only. The operation was performed on August 15, six days after the first examination. At operation the capsule was found thickened and too adherent to remove hastily. Bleeding was readily controlled.

The biopsy report was hypertrophy and chronic inflammation of the tonsil tissue. At my request further study of the specimen was done with the same diagnosis.

The child was reexamined one month postoperatively at which time the left tonsillar fossa was found filled with a large irregular friable mass, which bled at touch. There was increased enlargement of the cervical lymph glands on that side. The child looked pale and slightly cyanotic, and there was a secondary anemia. It was now quite obvious that the tonsil growth was malignant. The patient was rehospitalized and under the influence of only a narcotic a good portion of the friable mass was removed.

The biopsy report was as follows: Sections show a diffuse infiltration with mononuclear cells with fairly large nuclei containing moderate amounts of chromatin and varying considerably in size and shape. There are many mitotic figures. The reticulum is scanty; the blood vessels are rather numerous. Most of them, however, are of the sinusoid variety. There are no follicles. This picture is strik-

ingly different from that seen in the previous biopsy. Diagnosis: Lymphosarcoma.

The child was immediately referred to the Chicago Tumor Clinic for roentgen therapy. Ater six exposures failed to influence the tumor, treatment was discontinued. The patient was then taken to the Mayo Clinic where, after a few ineffective roentgen exposures, a tracheotomy was performed and the child discharged with a hopeless prognosis. On December 3, the child now in extremis was admitted to the Wesley Memorial Hospital for a course of a duodenal extract substance for cancer on which research was being carried out there. Death occurred on December 17, 1945, approximately four months after the first examination. Postmortem findings disclosed a generalized lymphosarcomatosis with lymphosarcoma particularly evident in the left superficial and deep cervical lymph nodes, in the left kidney and in the mesenteric glands.

SUMMARY

1. Lymphosarcoma of the tonsil is not common and is exceptionally rare in children.

2. Very few cases are recorded in the literature.

3. Classification of malignant tumors of the tonsil is briefly reviewed.

4. Examination of the whole tonsil and not a portion of it is essential to assure diagnosis.

5. Repeated biopsies may be required.

6. Lymphosarcoma is known to be radiosensitive. Prognosis is poor because, although the tumor may disappear and a hopeful outcome be apparent, patients succumb later to distant metastases.

7. Before any roentgen treatment is begun on the throat, the abdomen and chest should be examined and x-rayed for metastases.

8. A case of lymphosarcoma of the tonsil in a three-year-old boy with a rapidly fatal outcome is reported.

9. Roentgen therapy failed to influence the lymphosarcoma in this child or in the above recorded cases in children.

10. All the above recorded cases in children were in boys.

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LXXI

NEURINOMA OF THE LARYNX

REPORT OF A CASE

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In an excellent review of neurofibromas of the larynx, Smith[1] found 12 reported cases, five in the United States and seven in foreign publications. He reported three additional cases.

Of those reported, the ages of the patients varied from 6 years to 50 years and the distribution according to sex was about equal. Tumor size ranged from a nodule 3 x 8 mm. to a bilobulated mass removed in two pieces which measured respectively, 3.25 x 2 x 1.5 cm. and 3 x 2 x 1.75 cm. after fixation in alcohol.[2] The weight of this specimen was not recorded. In three instances, the tumor arose from the right aryepiglottic fold and from the ventricular band in a like number of cases. Other sites of occurrence were the left aryepiglottic fold and the true vocal cord.

Preoperative diagnosis of neurinoma was not definitely established in any of the reported cases nor in the case recorded in the present paper. This, in part, is due to the difficulty encountered in attempts at biopsy, as mentioned by Van Loon and Diamond,[3] and in part to the infrequent occurrence of this lesion in the larynx. The classification of the tumor has varied in accordance with the different opinions concerning the origin of the tissue. Suffice to say, the terms neurinoma, neurofibroma, and Schwannoma are generally considered to refer to the identical growth. None of the patients had Von Recklinghausen's disease. Colledge[4] has reported the removal of a pure fibroma from the right aryepiglottic fold in a patient with this particular disease.

In all the patients, chronic progressive hoarseness was the main complaint. Dyspnea was not a prominent symptom but it was present to some degree when the tumor was large enough to become obstructive. Except for a feeling of discomfort noted in two cases,

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Fig. 1.—External appearance of the tumor showing its smooth capsule.

there was no pain. Physical findings were usually those of a smooth tumor mass covered by an intact mucous membrane. In contrast, a malignant growth which has advanced to a size comparable to some of the neurinomas reported would probably cause pain and have ulceration. The case to be reported is typical.

REPORT OF A CASE

History: F. M., a white male, aged 44 years, was admitted to the hospital, May 19, 1947, with the complaint of severe hoarseness. He dated the onset of his severe hoarseness to three days previously, following a drink of raw whiskey upon which he had choked. However, subsequent history disclosed that his hoarseness had been prominent for three years prior to this time. The past and family histories were irrelevant.

Examination: The voice was reduced to a husky whisper of poor volume. There was slight dyspnea on exertion. Mirror examination of the larynx revealed a large, smooth, reddish mass filling the right side of the larynx and extending well past the midline so that a definite airway was not visible. The right arytenoid was fixed. There was good motion of the left.

Operation: Under local anesthesia, a tracheotomy was done the day after admission. Direct laryngoscopy three days later re-

Fig. 2.—Cut surface of the tumor.

vealed a large, smooth, rounded mass occupying the right ventricular band. The mucous membrane was intact throughout and slightly reddened. The mass felt solid but offered no resistance to the passage of a laryngoscope. Both true cords appeared to be normal except that the right did not move. Under general anesthesia of intravenous pentothal sodium, a laryngofissure was done May 29, 1947. The upper part of the larynx was filled with a large firm growth arising in the false cord on the right side. This was dissected free leaving the true vocal cord on the right and all the mucous membrane below the cord intact. The area of removal was closed with catgut suture. The larynx and the neck muscles were closed without drainage.

Postoperative Course: The tracheotomy tube was removed the next day and the patient had no difficulty in breathing. However, he developed a stridor 17 hours later and the tube was replaced. Mirror examination of the larynx at this time showed a very narrow airway and the mucous membrane of the right side was hemorrhagic and edematous. This condition persisted until his release from the hospital, June 6, 1947, the seventh postoperative day. No attempt was made to cork the tube. He was followed in the out-patient department and by the fourteenth postoperative day he had very little dyspnea on exertion with a full cork in the tube. However, mirror

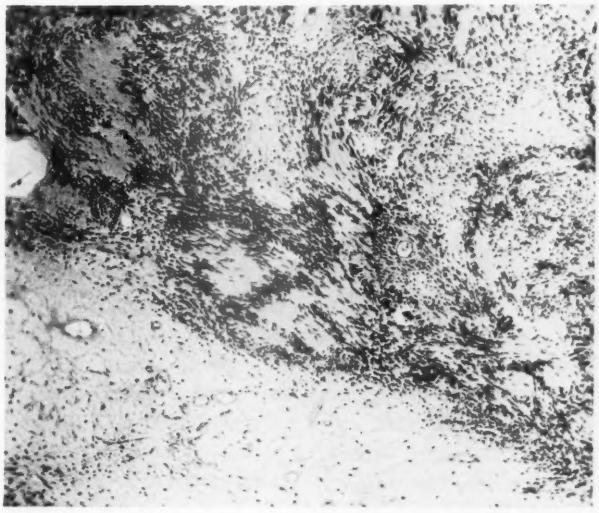

Fig. 3.—Low power photomicrograph demonstrating typical morphology of neurinoma.

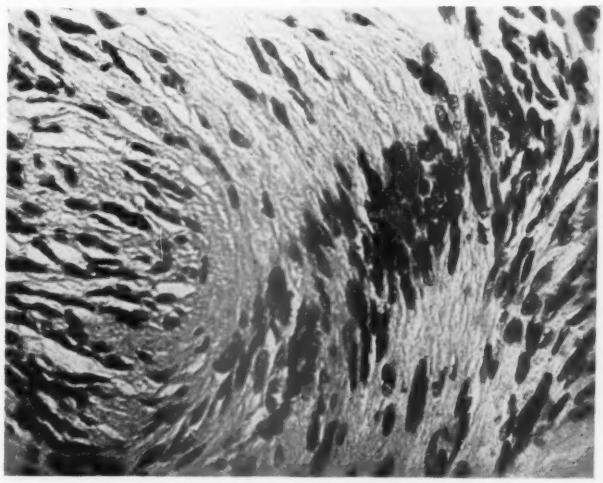

Fig. 4.—High power photomicrograph showing an area of palisading nuclei.

examination of the larynx continued to show marked swelling of the operative site, and the tube was not removed until a month after operation. At this time there was a good airway. The voice was husky but fairly clear and of good volume. There was no movement of the right arytenoid. Continued examinations disclosed a gradual reduction in the swelling of the right ventricular band but the true cord could not be seen on indirect examination. On September 3, 1947, there was still paralysis of the right side of the larynx.

Pathology: "Gross: (Figs. 1 and 2) The specimen is a smooth encapsulated mass which weighs 21 grams and measures 4.5 x 3 x 3 cm. On section it has a moderately firm stroma. It is grayish-white in color and has interstices filled with gelatinous material. It feels a little greasy but does not resemble fat grossly. Microscopic: (Figs. 3 and 4) The tissue is made up of spindle-shaped, connective tissue-appearing cells arranged in branching columns which occasionally form dense whirls. Prominent and most characteristic is the palisading of the nuclei which occurs in numerous foci forming the typical Verocay body of the neurilemmoma. These structures are scattered throughout the tissue. There is also edematous or myxomatous tissue throughout the section. Diagnosis: Neurinoma of the larynx.

Comment.—Vail advocates the transoral approach for removal of large laryngeal tumors to avoid paralysis of the true vocal cord. Paralysis of the true cord does not necessarily follow removal of supraglottic tumors by the external route. Perusal of the literature shows that in cases of postoperative paralysis, the status of the affected side of the larynx was not recorded prior to operation. The observations in this patient suggest that the paralysis in the previously reported cases may have been present before operation. The pertinent data are given in the accompanying table.

Paralysis of the cord, either preoperatively or postoperatively, is difficult to explain on an anatomical basis. The tumor mass is usually above the true cord and well encapsulated. In this case it was removed without difficulty or trauma to the true cord, subglottic area, or recurrent laryngeal nerve. Pressure of the tumor mass cannot be the answer because following removal of the growth there should be a restoration of function. In the three months since operation, there has been no indication of recovery of motion in this patient and the two total and one partial paralyses listed in the table were evidently permanent. Furthermore, the patient with

PRE- AND POSTOPERATIVE MOTILITY OF VOCAL CORDS IN NEURINOMAS OF THE LARYNX

(Removed by External Approach)

	SIZE	SITE	PREOP.	POSTOP.
1.	3 x 1.5 x .5 cm.	Right aryepiglottic fold	Normal	Normal
2.	2.5 cm. diameter	Left ventricular band	Normal	Normal
3.	Unknown	Left aryepiglottic fold	Normal	Normal
4.	3 cm. diameter	Left ventricular band	Normal	Sluggish
5.	3 x 2.5 x 2 cm.	Left aryepiglottic fold and ventricular band	Not listed	Paralysis
6.	Walnut	Left aryepiglottic fold	Not listed	Paralysis

the largest tumor of this type reported[2] did not have any paralysis as would have been expected if pressure were responsible.

SUMMARY

Neurinoma of the larynx is a rare condition. The diagnosis in all 16 cases reported has been made postoperatively from study of microscopic sections. Paralysis of the affected side may be present before operation. Complete removal is the only therapy necessary and the prognosis is good.

CARLE HOSPITAL CLINIC.

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LXXII

UNUSUAL LARYNGEAL LESIONS

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AND
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It is the purpose of this paper to present several recent laryngeal cases of considerable pathological and clinical interest, two of carcinoma and one of amyloid disease.

CARCINOMA

Jackson and Jackson[1] refer to a case of coexisting pulmonary and laryngeal cancer. The following is a case of dual respiratory tract carcinoma with a nine-and-one-half-year interval between the two lesions.

Case 1.—J. J. M., aged 39, was admitted to the Massachusetts General Hospital in May 1937, complaining of severe cough of 20 years' duration, productive of one-half cup of sputum daily for the last seven years. Five years before entry he was examined at the State Tuberculosis Sanatorium and found to have tubercle bacilli in the sputum and x-ray evidence of active tuberculous pulmonary infection. After appropriate rest, his symptoms improved considerably, his sputum became negative, and the x-ray film of his chest showed healed fibrous tuberculosis. One year before entry he began to lose weight and strength and he had had blood-tinged sputum for five months. Thinking that he had a return of his tuberculosis, he returned to the State Sanatorium where the chest x-ray film showed a mass in the right hilum with healed fibrous tuberculosis and partial atelectasis of the right lower lobe. Tubercle bacilli could not be found in the sputum, but on bronchoscopy a mass was found in the right middle lobe bronchus which proved to be grade III epidermoid carcinoma. At the Massachusetts General Hospital on May 26, 1937, the patient had a total right pneumonectomy. The lung showed old healed fibrotic tuberculosis without evidence of activity and a large

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mass, grade IV epidermoid carcinoma, at the junction of the middle and lower lobe bronchi. The mediastinal lymph nodes were negative for metastatic carcinoma.

Postoperatively there was a persistent empyema, but after several thoracoplasties the discharging chest sinus closed. Following the final thoracoplasty in 1940 he had little trouble other than continued cough and sputum until April 1946, when he developed pneumonia in his remaining lung. As a sequela, he was weak, had dyspnea on exertion, and occasionally had sharp chest pain on exertion. An electrocardiogram showed changes consistent with coronary heart disease, but there was never any physical evidence of heart failure or coronary occlusion. The left lung had a moderate degree of compensatory emphysema.

In October 1946, at the age of 48 and over nine years following pneumonectomy, he was admitted to the Massachusetts Eye and Ear Infirmary complaining of increased cough, sputum, and a hoarseness of two months' duration. On examination the anterior three fourths of the right true cord was ragged and moth-eaten but the mobility appeared normal. The biopsy showed only chronic inflammation. Under observation the lesion was seen to progress with definite fixation of the cord and a second biopsy five weeks after the first confirmed the clinical impression and was reported as grade II epidermoid carcinoma. A total laryngectomy was done in February 1947, using a "T" incision and a wide field technique. The postoperative course was uneventful and he was discharged from the hospital in three weeks.

Comment. Multiple primary malignant neoplasms are not unusual and are apparently occurring with increasing frequency. In 1932 Warren and Gates[2] found the incidence to be 1.84 per cent of cancer cases from all reports and 3.9 per cent of cancer cases in America. Triple primary malignant neoplasms comprise a small percentage of multiple malignancies; however, a case involving the larynx, nose and skin of the temple, with survival, was reported by Drooker.[3]

Dual or triple neoplasms may either coexist or occur with a free interval. This case illustrates what may be expected to occur with increasing frequency as our success in treating malignant neoplastic diseases becomes greater. As the neoplastic diathesis or cancer substrate is in no way altered by surgical or radiological treatment, patients who are treated successfully for cancer may well develop an independent neoplasm at some time in the future with the identical

predisposing and exciting factors operating. In this particular case chronic infection and irritation may well have been an important exciting factor in the etiology, since the patient had chronic productive cough for seven years prior to his bronchial carcinoma and for almost ten years after pneumonectomy before the laryngeal carcinoma developed. It should be of interest that this man survived such a notoriously difficult to control disease as bronchial carcinoma and a pneumonectomy with subsequent persistent empyema in the days before chemotherapy and lived to develop laryngeal carcinoma almost ten years later.

This patient with one lung and evidence of beginning arteriosclerotic heart disease presented a problem in anesthesia. It was decided to do the operation under intratracheal gas-oxygen ether anesthesia which the patient took well. At the operation there was nothing to suggest extralaryngeal extension of the tumor. The pretracheal muscles were removed and there was no metastatic lymph node disease seen or felt along the carotid sheaths. The lesion on the right cord was large; it had destroyed most of the right true cord and extended subglottically. There should be every reason to expect a good result in so far as the laryngeal lesion is concerned, although he may develop a third primary neoplastic lesion or have pulmonary difficulties associated with extensive compensatory emphysema of the left lung.

Recurrence of cancer after apparent removal is one of the prime features of malignant neoplastic disease. Assuming a unicentric focus of cancer cells, recurrence may be due either to incomplete removal or subsequent development of another unicentric system of autonomous cells. The following is a case of recurrent laryngeal carcinoma with an eight-year free interval during which a second lesion developed which was probably also primary.

CASE 2.—L. N., aged 64, white, male, was first admitted in December 1938, with a complaint of hoarseness of five to six months' duration. On examination there was a slight asymmetry of the epiglottis and a pedunculated polypoid mass, perhaps 2 mm. in diameter, arising from the medial surface of the anterior one third of the right true cord. Both cords were freely movable. The pedunculated growth was removed under Lynch suspension laryngoscopy, and on microscopic examination it proved to be grade II epidermoid carcinoma. The patient was advised to have a laryngofissure but refused treatment of any kind. He disappeared from the clinic and was not seen again until November 1946, at which time he complained of

hoarseness of about three months' duration. During the interval since 1938 his voice had returned to normal and had remained so and he had had no treatment of any kind other than the biopsy. Examination in November 1946, showed asymmetry of the epiglottis identical to that which was noticed before. The anterior one half of the right true cord was slightly irregular and ulcerated and the cord moved well. A specimen from the ulcerated area showed grade II epidermoid carcinoma and a laryngofissure was done in December 1946.

Comment. This is an instance of recurrence of carcinoma in an identical location after a free interval of eight years with no treatment whatsoever other than simple biopsy. At the time of the first operation in 1938, the lesion was a polypoid mass and probably was removed in toto, effecting a truly successful biopsy. If some cancer cells were left, the only alternative to this assumption is that this patient may have unusual tissue and humoral resistance to malignant neoplastic disease or that the cancer cells assumed a dormant state. Since the laryngofissure in 1946, he has done well and like all cancer patients is still under observation.

AMYLOID DISEASE

Amyloid degeneration may occur within benign or malignant tumors or it may be secondary to long-standing chronic inflammatory diseases such as tuberculosis and osteomyelitis, but there is a type of amyloid disease which develops without any known cause and is termed primary idiopathic amyloid disease. This primary type of amyloid disease may be either systemic or localized, the latter being most frequent. Up until 1945, 38 cases of primary systemic amyloid disease were reported and in many of these parts of the upper respiratory tract and oral cavity were involved.[4, 5] The tongue was found to contain amyloid deposits most frequently and the pharynx, larynx, and esophagus were often involved. Localized primary amyloid disease is more frequently encountered than the systemic type and the upper respiratory tract, especially the larynx, is likely to be the seat of the disease. In these areas the amyloid material usually forms tumor-like masses with a waxy surface.

Although the most common site of this localized type is in the upper respiratory tract, and particularly the larynx, the disease is infrequently met with. Jackson and Jackson[6] refer to six cases. Kramer and Som[7] reported a case in 1935 similar to the present one and were able to find a total of 95 cases limited to the upper respiratory tract. At least one well-established case has been observed at

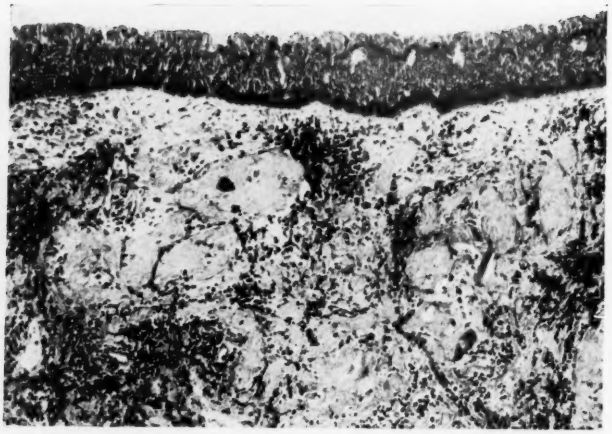

Fig. 1.—Photomicrograph (X78) showing subepithelial amyloid deposits in the tunica propria of the laryngeal mucous membrane.

the Massachusetts Eye and Ear Infirmary during the past two years and is here reported.

CASE 3.—A. G., aged 20, white, female, was first seen at this hospital in July 1945, at which time the chief complaint was intermittent hoarseness of two years' duration, constant hoarseness of two months' duration. The hoarseness started and progressed rather gradually until at the time of examination she was unable to speak above a whisper. She had no difficulty in swallowing but recently she had had some difficulty in breathing on exertion; she had had 15 pounds weight loss in nine months.

On examination of the larynx there was a large proliferating mass of adenoid-like tissue on the posterior surface of the epiglottis beginning near the tip and extending downward, mostly on the left side of the larynx, toward the epiglottic tubercle and as far as the left false cord. This mass completely obscured the vision of the left true cord. Under direct laryngoscopy, a large amount of this abnormal tissue was removed with biting forceps; after pathological examination of this tissue the diagnosis was amyloid disease. The subepithelial connective tissue was densely infiltrated with amorphous hyaline material which was unmistakably amyloid deposition (Fig. 1).

Postoperatively, the voice improved considerably but the hoarseness persisted somewhat and in January 1946, a moderate amount of recurrent tissue was removed from the same area. Recently she has had some return of hoarseness and more tissue may need to be removed.

On general physical examination her blood pressure was 115/65 and there were no significant abnormalities found. There was no evidence of chronic inflammatory disease and no evidence of extralaryngeal amyloid disease. The x-ray film of the chest was negative, the Wassermann test was negative, plasma proteins and nonprotein nitrogen were within normal limits, and the Congo red test showed a 59 per cent retention after one hour which was interpreted as being a borderline test. At the time of the Congo red test the larynx was examined to see if there was any visible change in the color of the tumor-bearing area and a change could not be identified.

Comment. This case is very similar to the one described by Kramer and Som and in all probability represents the typical nature and course of primary localized laryngeal amyloid disease. Since it is almost impossible to remove all the abnormal tissue, the "tumor" tends to recur and may require repeated removals. When the "tumor" is large and subglottic as in the case described by Figi,[8] it is preferable to do a thyrotomy with removal and electrocoagulation of the base of the wound. The effect of x-ray on this disease has not been tested here.

SUMMARY

1. Two noteworthy cases of laryngeal carcinoma are presented. In one a situation of dual respiratory tract carcinoma with a nine-and-one-half-year free interval is encountered, and in another recurrence in an identical location eight years following simple biopsy is described.

2. A case of localized primary idiopathic amyloid disease confined to the larynx is reported.

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LXXIII

PLASMA CELL TUMORS OF THE NASOPHARYNX

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Extramedullary plasma cell tumors occur rarely compared with those arising in the bone marrow. Hellwig[1] reviewed all the extramedullary plasmocytomas reported in the literature up to 1942. Only 13 out of the 128 cases in his report originated in the nasopharynx. The exact number can only be estimated because some of these tumors secondarily invaded the nasal and paranasal cavities. Most probably plasmocytomas of the nasopharynx are much more frequent than is apparent from the literature. Many nasopharyngeal polyps are not studied microscopically due to their benign appearance and some of these tumors are so small and grow so slowly that they remain undiscovered before death.[2]

In Hellwig's series six out of the 13 nasopharyngeal plasmocytomas were solitary "noncancerous" tumors, three were multiple "noncancerous" tumors, two were "cancerous" without metastases and two were "cancerous" with metastases to the bones. The above classification was based on the clinical behaviour of the growths.

Plasmocytomas of the nasopharynx were described as polypoid or sessile growths or as a more or less circumscribed swelling of the mucous membrane. Some of the tumors had filled the greater part of the nasopharynx at the time of the diagnosis while others had only reached the size of a bean. The color was usually pale to dark red.

Very little is known about extramedullary plasmocytomas. It is hoped that early detection of these tumors associated with long follow-ups will help to clarify this moot chapter of pathology.

CASE 1.—A 38-year-old white male was first seen two years ago. The patient complained of continuous nasal discharge, nasal obstruction, greenish crusting, postnasal drip and foul-smelling breath of 20 to 25 years' duration. He had been under treatment

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for sinusitis for the previous 15 years and had undergone two nasal operations, one of which was a submucous resection. All previous treatment had failed to produce any improvement in his symptoms. His general health was satisfactory.

On physical examination mucoid exudate was found in both nasal chambers without evidence of an overflow from the sinuses. The left maxillary sinus was very hazy on transillumination but irrigation revealed no exudate. X-ray studies of the sinuses revealed generalized thickening of the mucous membranes but no fluid.

In the nasopharynx there was a dark red, sessile growth, the size of a small bean, with a smooth surface; it was located about 15 mm. above the pharyngeal opening of the right eustachian tube. The posterior nares and the vomer could not be visualized in the mirror on account of a pale greyish membrane located in the coronary plane, which separated the nasopharynx into a smaller anterior and a larger posterior compartment. This membrane was located behind the level of the choanae and connected the two lateral walls and the roof of the nasopharynx. The two compartments intercommunicated through a small hole measuring 3x3 mm. which allowed the passage of a small applicator from the right nostril into the posterior compartment. A large amount of greenish, crusted exudate covered the walls of the nasopharynx.

Examination of the urine and the blood revealed nothing abnormal. The sedimentation rate was 13 mm. per hour and the Kline test was negative.

In view of the above findings a tentative diagnosis of angioma and congenital membranous malformation of the nasopharynx was made and the growth was removed under general anesthesia. The membranous diaphragm was removed with the fingers. Following this procedure the posterior tips of the turbinates and the posterior edge of the vomer could be easily visualized in a mirror.

Histological examination of the growth showed that it consisted of a large number of closely packed plasma cells which varied slightly in size. They were irregularly arranged in masses separated by slender, fibrous tissue strands. The growth was covered by thin, stratified squamous epithelium. There were occasional lymphocytes and polymorphonuclear leukocytes in the tumor. Diagnosis: plasmocytoma of the nasopharynx.

Following the histological examination the urine was tested for Bence-Jones proteins. It was negative. X-ray studies of the skull,

the entire spine, the chest, and the upper and lower extremities did not reveal any lesion which could be interpreted as a myeloma. The patient was then given a course of deep x-ray therapy to the nasopharynx.

The patient showed no recurrence two years postoperatively. A longer follow-up was impossible because of the patient's departure from the United States.

CASE 2.—A 61-year-old female was first seen by another physician[4] in March 1937. Her complaints consisted of complete obstruction of the right nostril and difficulty in nasal respiration of seven months' duration. For four years the patient had noticed an increasing stuffiness in her nose unaccompanied by discharge.

On examination of the nasopharynx a firm growth with a smooth surface was found filling its right half and obstructing the right choana. There was no evidence of enlarged regional lymph nodes. X-ray studies revealed a dark right maxillary sinus.

Under general anesthesia the soft palate was elevated and several sections of the tumor were removed for microscopic studies. Bleeding was controlled by pressure.

Microscopic studies showed that the tumor consisted of a delicate framework of fibrous tissue bearing blood vessels which enclosed masses of tumor cells of the plasma cell type. These were quite well differentiated and mitosis was found on an average of one in every two high-power fields. The cell cytoplasm was more acidophilic than normal plasma cells. Diagnosis: plasmocytoma of the nasopharynx.

The patient received x-ray therapy to the nasopharynx through each lateral temporozygomatic region and through an anterior nasolabial field.

Two months later at the termination of radiotherapy the tumor was smaller but still quite prominent.

Two and a half years later, in September 1940, the patient suffered a pathological fracture of a leg for which condition the leg had to be amputated in an out-of-town hospital. No evidence of nasopharyngeal growth was found at this time.

Sections taken from the amputated leg showed a highly cellular tumor which was fairly sharply demarcated from the adjacent soft tissues but was not encapsulated. The cells composing the tumor were medium sized and generally round. However, where they were

closely packed they tended to be polygonal. The nuclei were round, contained fairly prominent nucleoli, and tended to be eccentrically located. The cytoplasm was homogeneous, prominently acidophilic and considerable in amount. A few of the cells were multinucleated. Although there was no distinct membrane, the cell outlines were sharp. Mitosis averaged one in every three to four high-power fields. The tumor cells were supported by an extremely delicate fibrous stroma. Foci of hemorrhage and necrosis were present. An attempt to demonstrate the plasma cell character of the tumor cells by special stains gave negative results. The tumor was unquestionably the same type of tumor as was present originally in the nasopharynx. Diagnosis: plasmocytoma of the femur following plasmocytoma of nasopharynx.

No further follow-up was possible. The patient died three years after the pathological fracture.

DISCUSSION

In Case 1 the plasma cell tumor was small, solitary and noninfiltrating. The amount of time that elapsed between the first and last examinations, a period of two years, is not sufficient for a final evaluation of the character of this growth. On the other hand, it is evident from the literature that a primarily benign plasmocytoma may show malignant behaviour many years after its discovery. The growth in Case 1 might have been present for many years prior to its discovery. In this instance a routine examination of the nasopharynx for postnasal drip led to the discovery of the tumor. A small nonobstructing plasmocytoma of the nasopharynx can be asymptomatic and will not affect the patient's general health as long as metastases do not occur or as long as the base of the skull is not invaded.

There are several difficulties involved in making a prognosis in these cases. In Pollock's[2] case a very small nasopharyngeal plasmocytoma was found, accompanied by extensive bone lesions. The size of the tumor allows only a limited lead as regards the prognosis. Some of the subclinical bony foci can be detected by x-ray studies of all the skeletal bones and by the Bence-Jones test of the urine. It seems to be a general experience that Bence-Jones proteins are not found in extramedullary plasma cell tumors as long as bone foci do not occur.

The clinical problem is made more complicated by the opinion of some pathologists who claim that extramedullary plasmocytomas

are simply parallel manifestations of the same disease, multiple myeloma. Even very long follow-ups of patients with extramedullary plasmocytomas showing no bone involvement can not completely invalidate this contention. Oppikofer[3] found a patient in good health 31 years after the discovery of multiple plasma cell tumors in the larynx, nasopharynx and nasal cavity. On the other hand, in other cases foci were observed several years after the removal of the primary tumor. It seems almost impossible to make a reliable statement as to the prognosis based on the clinical appearance of the tumor alone no matter how benign it may look.

The histological character is an equally poor aid in making a prognosis. The character of the tumor of Case 2 in no way indicated the malignant course which later caused extensive bony metastases. It is noteworthy that about ten years elapsed between the occurrence of the first nasal symptoms and death in Case 2, while metastases became evident three years before death. Other plasmocytomas reported in the literature showed an altogether benign behavior in spite of a great number of tumor cells which showed polymorphism, multinuclearity and atypical mitosis.

As long as neither the clinical anatomical appearance nor the histological picture can give us a reliable indication of the future course of these tumors, an early radical removal of the extramedullary tumor associated with deep x-ray therapy seems to be indicated in every instance. Irradiation should be tried in addition to surgery in spite of the fact that not all plasmocytomas of the mucous membranes of the air passages respond to irradiation. Neither the clinical nor the histological character of the tumor gives any indication as to the radiosensitivity of the individual tumor.

SUMMARY

Two cases of nasopharyngeal plasmocytomas are reported as an addition to the 13 cases already published in the literature.

Neither the clinical appearance nor the histological character of these tumors is a reliable indication as to the prognosis at an early stage of the disease.

Surgical removal followed by deep x-ray therapy is indicated in every case of nasopharyngeal plasmocytoma.

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LXXIV

MUCOCELES OF FRONTAL AND ORBITAL CELLS

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Mucoceles of the ethmoid are not uncommon and the diagnosis is not difficult if the mucocele bulges either into the nose or into the orbit. The symptoms are presented in every textbook of rhinology. However, the expansion of a mucocele of the ethmoid toward the frontal sinus is frequently not even mentioned. The reason is simple. A mucocele of the ethmoid, which extends toward the frontal sinus, does not cause definite symptoms if there is a large frontal sinus which furnishes space for a considerable extension of the mucocele; even x-ray films usually do not indicate the correct diagnosis. If, however, a mucocele of this type has replaced or has even expanded the frontal sinus, the mucocele is usually considered to be a frontal and not an ethmoidal mucocele.

Mucoceles of frontal and orbital cells are not particularly rare because, under normal conditions, the encroachment of ethmoidal cells on the frontal sinus or on the roof of the orbit is by no means uncommon. It is evident that frontal or orbital cells may be transformed into mucoceles if their communication with the nasal cavity is impeded. In fact, as early as 1901 Avellis[1] advanced the opinion that the mucocele of the frontal sinus, if it is nontraumatic in origin, does not actually concern the frontal sinus; it is rather caused by a mucocele of the anterior ethmoid which bulges into the frontal sinus similarly to a dental cyst which bulges into the maxillary sinus. The view of Avellis has not met with general approval because his case apparently was not sufficiently analyzed to permit these far-reaching conclusions. In the following years several cases were studied which proved that Avellis went too far in generalizing his hypothesis. It is true that a mucocele of the ethmoid may bulge into the frontal sinus as well as into the nose or the orbit, but this does not imply

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that, in general, mucoceles of the frontal sinus are actually mucoceles of the anterior ethmoid. On the contrary, experience proves that in some cases there may be an association of a mucocele of the anterior ethmoid and a mucocele of the frontal sinus.

Unfortunately mucoceles of the frontal and orbital cells were not frequently reported as morbid entities. Recently Greifenstein[2] has reported two cases of pyocele which became manifest 19 and 31 years, respectively, after a Killian operation on the frontal sinus. In one of these cases there was a bilateral pyocele, subsequent to a bilateral Killian operation 19 years previously. On the left side the reoperation revealed a mucocele of the frontal sinus, and protruding into the frontal sinus, a pyocele of the anterior ethmoid. Mucocele and pyocele were separated by a thin bony wall. Although there was a mucocele of both the frontal and the ethmoid sinus, there were no ocular symptoms. Greifenstein emphasizes that mucoceles subsequent to operations on the frontal sinus are not common. In a review of 276 external frontal operations Weille[3] found 16 postoperative mucoceles or pyoceles. They were found to be commoner following Jansen-Lynch or Killian operations (13 cases) than after obliteration of the frontal sinus (3 cases). However, it seems that in some of Weille's cases, the pyoceles did not concern ethmoidal cells, but originated within the recesses of the frontal sinus which were not thoroughly obliterated at the original operation and became refilled with pus or mucus subsequent to the operation.

A rather complex problem is offered by a case of Lillie's and Simonton's.[4] This patient complained of headache over the left eye for nine years. An intranasal operation had relieved the pain for two years. Occasional relief would be afforded after a gush of straw-colored discharge from the left nostril. The nasal examination revealed scars from operations on all the sinuses, but there were no secretion and no ocular symptoms. On the x-ray film there was a general clouding of all the sinuses. The right frontal sinus extended beyond the midline. The left frontal sinus was densely clouded. An external frontal sinus operation was performed. The lining membrane of the sinus was markedly thickened. A bone cyst was found in the lateral portion of the sinus. The attachments of the cyst were not determined. The surgeon considered the structure an anterior ethmoid cell situated within the lumen of the left frontal sinus.

REPORT OF CASES

CASE 1.—W. L., white, male, aged 37, had an operation on both frontal sinuses 16 years ago. After the operation there were

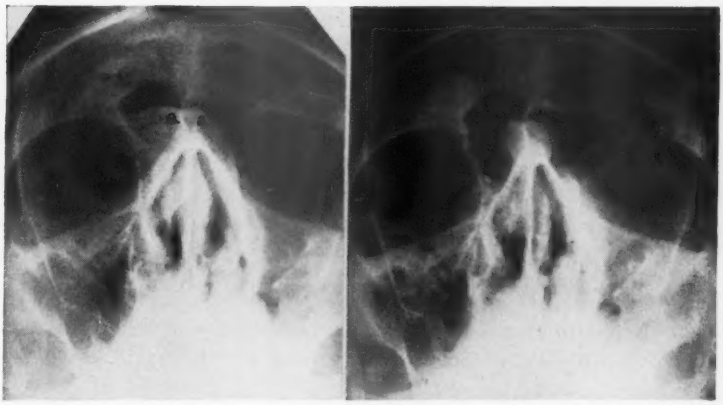

Fig. 1, Case 1.—X-ray film taken prior to the operation; *a* shows the area of the pyoceles.

Fig. 2, Case 1.—X-ray film taken after the operation.

no headaches, but the purulent discharge from both nostrils persisted. Two weeks ago he caught a cold and had severe pain over the left eye, radiating toward the vertex. Simultaneously a swelling appeared over the glabella. There was no fever. He was treated endonasally and penicillin tablets were administered. The swelling over the glabella decreased and the headache disappeared. One week later he again complained of headache, at that time over the right eye, and the swelling over the glabella reappeared. He was treated with intramuscular injections of penicillin. The headache improved, but the swelling did not disappear.

On April 4, 1947, there was a swelling, the size of a walnut, at the glabella. The skin was slightly red but there was no fluctuation. The supraorbital ridge was normal on the right side; on the left there was apparently a defect at the mesial portion of the ridge. There was no tenderness of the supraorbital nerves. There was a scar in the left eyebrow which extended over the bridge of the nose to the right eyebrow. There was no scar at the frontal processus of the maxilla. The greater part of the middle turbinate was absent on both sides; the middle meatuses were filled with hyperplastic mucosa. There was no pus. The left nasofrontal duct was patent; the right was narrow. Irrigation of the left maxillary sinus did not reveal pus.

No pus could be forced into the nose by pressure exerted on the swelling at the glabella. X-ray films (Figs. 1 and 2) showed a cloudiness of the left maxillary, the left ethmoid and both sphenoid sinuses. Both frontal sinuses were cloudy; the boundaries of the right frontal sinus were distinct, the boundaries of the left frontal sinus slightly indistinct. In the lateral portion of the left frontal sinus the bone was sclerotic and in this area there were two ring-like translucent spots with distinct boundaries which we considered to be cells of the lateral recess of the frontal sinus.

On April 10, 1947, an arcuate incision was made on the left side. The mesial portion of the supraorbital ridge consisted of sclerotic and uneven bone which was movable and separated from the thickened bone of the frontal process of the maxilla by a slit. The lateral portion of the supraorbital ridge consisted of sclerotic and uneven bone. There was no opening in the frontal process. The anterior part of the floor of the frontal sinus was absent and the periorbit, covered with granulations, bulged into the sinus. The entire supraorbital ridge and a part of the sclerotic bone of the lateral wall of the frontal sinus were removed. A wide drainage passage into the nose was created through the thickened frontal process. The ethmoid was curetted. The posterior wall of the frontal sinus consisted apparently of a bony plate which was extremely thin and had a bluish appearance. After perforation of the bony plate a great amount of nonfetid pus escaped. In other words, the bony plate was not actually the posterior wall of the frontal sinus but the anterior wall of a dilated frontal cell which bulged into the frontal sinus. This pyocele extended mesialwards to the interfrontal septum (Fig. 3); lateralward it passed into a small pneumatic cell which was filled with pus and extended into the sclerotic bone lateral to the frontal sinus. It is likely that this caused the ring-like structure which was discovered on the x-ray film. The opening of the nasofrontal duct was situated in front of the pyocele. At the glabella the anterior wall of the frontal sinuses together with the anterior portion of the frontal septum had been removed at the first operation. At this site a localized abscess was found between the skin and the remnant of the frontal septum, causing the bulging of the skin.

On the right side a small part of the anterior wall of the frontal sinus and of the supraorbital arch were removed at the first operation. The frontal sinus was normal. On this side there was likewise a dilated frontal cell, the dilation being caused by a large plug of mucopus (mucocele). The opening of the nasofrontal duct was in

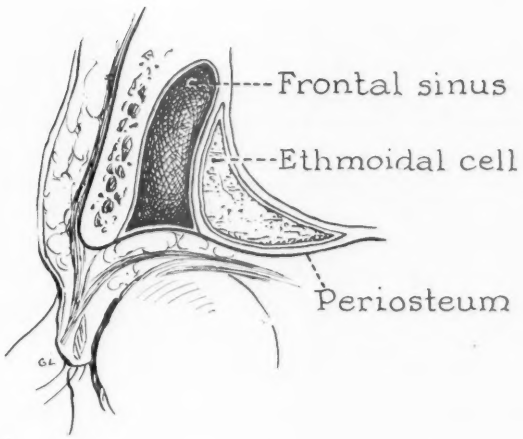

Fig. 3, Case 1.—Schematical drawing showing the findings at operation.

front of the mucocele. The frontal process of the maxilla was thickened and movable. The large sequestrum was removed exposing the ethmoid which was filled with polypoid tissue. The operation resulted in a large groove with several bony ridges. The floor of the groove was the posterior wall of the pyoceles of the frontal cells. The lining membrane of this wall was normal.

Large rubber tubes were inserted through the nostrils into both frontal sinuses and left in place for eight days. The frontal sinuses were filled with vaseline gauze and the lateral parts of the skin incision were left open. There was an uneventful recovery. On May 9, 1947, the patient felt fine. Both nasofrontal ducts were patent and the area of the ethmoids was smooth. The nasal mucosa was normal except for a slight hyperplasia at the left middle turbinate.

Comment: In this case a frontal sinus operation had been performed which had consisted of removal of the anterior wall of the sinus at the glabella, removal of the anterior portion of the frontal septum, removal of the floor of the left frontal sinus. The frontal processus of the maxilla was left intact on both sides. According to these findings it is likely a Lothrop operation or a Lothrop-like operation had been performed. The result of the operation was excellent as far as the subjective symptoms were concerned: there were no headaches for 16 years. However, the result was not so good as far

as the objective symptoms were concerned. The purulent discharge from the nose did not cease although the patient never noticed a sudden gush of secretion from the nose. The purulent discharge was caused by a chronic osteomyelitis of the primary type of the processus frontalis of the maxilla on both sides which caused a thickening of the frontal process on the left side, a sequestration of the frontal process on the right side and a sequestration of the orbital arch on the left side. The osteomyelitis occurred although both nasofrontal ducts were patent, the left being large, the right duct being narrow. This proves that the frontal sinus operation after the technique of Lothrop does not prevent the establishment of a chronic osteomyelitis of the primary type which involves the frontal process of the maxilla and the supraorbital arch.

Another unfavorable feature of this technique is that no radical curettage of the ethmoid is done. This is a decisive factor because in practically all instances in which there is an indication for an external frontal sinus operation the ethmoids likewise require radical surgery. In the presented case the absence of parts of the middle turbinates indicates that apparently an endonasal operation on the ethmoids was performed in addition to Lothrop's operation. This operation, however, was not successful and, for this reason, the ethmoid infection persisted, causing finally a pyocele of the frontal cells of the anterior ethmoid (Fig. 3). It is likely that the pyoceles were not present, at least not in a considerable size, when the Lothrop operation had been performed. Otherwise the surgeon would scarcely have missed them and they would have reached a larger size in a period of 16 years than they did. The pyoceles bulged into the frontal sinus, displacing the opening of the nasofrontal ducts toward the anterior wall of the frontal sinus. But there was no extension of the pyoceles toward the orbit or the nose and, for this reason, the diagnosis was not made prior to the operation. The length of time the pyoceles were in existence cannot be stated; however, it is likely that they would have persisted for a longer period of time, if the acute abscess at the glabella had not required a reoperation. This abscess was situated between the skin and the anterior wall of the pyoceles; in other words, the abscess occupied the space which normally is filled by the anterior wall of the frontal sinus and the anterior portion of the frontal septum. It cannot be stated whether the infection entered this space through the nasofrontal ducts or through the skin or through the anterior wall of the pyoceles, or whether it originated from the chronic osteomyelitis of the frontal processus. However, it can be stated that the abscess had no communication with the nasofrontal

Fig. 4, Case 2.—X-ray film taken prior to the operation.

ducts and for this reason external pressure on the abscess did not cause the pus to escape through the ducts. Adhesions between the skin and the anterior wall of the pyoceles furnished a barrier between the abscess and the openings of the nasofrontal ducts. This is an interesting finding because the Lothrop operation is supposed to drain particularly the mesial portion of the frontal sinus viz., that space where the pus had accumulated in the presented case. From this finding the conclusion must be drawn that the Lothrop operation did not achieve its purpose in the presented case. But this conclusion should not be generalized inasmuch as even in the presented case it took 16 years until a reoperation had to be performed.

CASE 2.—R. E. F., white, male, aged 58, developed an inflammation of the left eye in December, 1934. A radical operation of the left maxillary sinus was performed on January 22, 1935, and the patient made an uneventful recovery. An x-ray film which was taken in January 1935 showed a very large frontal sinus on the left side which contained a great number of bony septa, particularly in

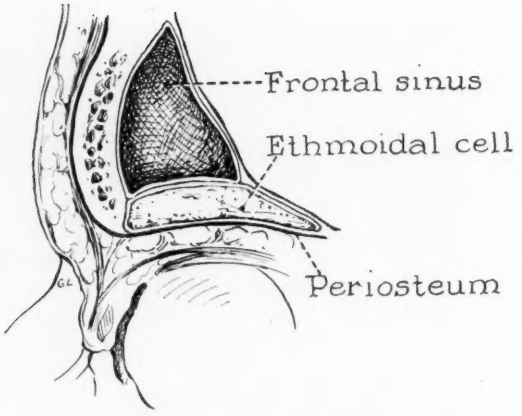

Fig. 5, Case 2.—Schematical drawing showing the findings at operation.

the lateral recess. The left frontal and ethmoid sinuses were cloudy but the boundaries of the sinuses were distinct. In August 1937 it was noticed that the patient's left upper eyelid did not move. There were slight pains in the left forehead and in the right occiput. In October 1937 the patient complained of difficulty in hearing and tinnitus. There was no history of a head injury.

On December 18, 1937, there was a ptosis on the left side and the left eye was displaced downward. In looking upward he complained of double vision. The right pupil was larger than the left. An x-ray film of the skull did not show any pathologic changes. The diagnosis of encephalitis was made and the patient was treated with x-rays. An x-ray film, taken on December 29, 1937, showed a marked cloudiness of the left frontal sinus and the left maxillary sinus and a slight cloudiness of the left ethmoid (Fig. 4). Blood examination was negative. On January 7, 1938, an exophthalmos was found on the left side. The left eye was displaced downward and there was a ptosis on the left. The supraorbital arch on the left side was markedly thickened. The diagnosis of a tumor of the left orbit was made. When the patient was seen for the first time, there was a slight swelling of the mucosa of the left middle meatus of the nose but there was no pus. There was no tenderness or bulging in the area of the left frontal sinus. In probing the left nasofrontal duct a resistance was felt about 1 cm. above the infundibulum. There was no infection in the nasopharynx.

On January 17, 1938, an operation was performed under local anesthesia. An arcuate incision was made on the left side and the thickened orbital arch was exposed. The floor of the frontal sinus was absent and was replaced by a cyst-like sac, bluish in color which could be pressed toward the frontal sinus. The anterior wall of the frontal sinus was markedly thickened and sclerotic. A part of this wall was removed, thus exposing a thickened bluish membrane which did not move on deep respiration. The membrane was further exposed toward the nasofrontal duct and a part of the frontal process of the maxilla was removed. During this maneuver an opening was made in the membrane. A great amount of thick, nonfetid pus escaped and the membrane fell back into the frontal sinus. No bacteria were found in the pus. The membrane was incised and the frontal sinus was found to be filled with thick pus. The mucosa was in some areas necrotic, but otherwise normal, and was not removed. A part of the thickened frontal septum was likewise removed and the right frontal sinus was found to be normal. Now the entire anterior wall of the left frontal sinus was removed. The ethmoid was curetted and a large communication was created between the frontal sinus and the nose. Inspection of the left frontal sinus revealed that the floor of the sinus was membranous and bulged toward the sinus. Beneath the floor was the cyst-like sac which had been exposed at the beginning of the operation and which was situated between the frontal sinus mucosa and the periorbit (Fig. 5). There was no bony wall between the mucosa and the wall of the cyst-like sac. If pressure was exerted upon the sac, pus escaped from the frontal sinus into the nose, but the cyst-like sac did not change its size. Even greater pressure on the sac did not change its size. This proves that the sac had no communication either with the frontal sinus or with the nose. Further exposure of the sac revealed that it occupied a groove in the frontal squama, lateral to the frontal sinus, and that it ran within the orbit toward the posterior part of the lamina papyracea, turning into a narrow duct in the depth of the orbit. At the lamina papyracea and close to the optic foramen the sac was cut off. It was filled with pus which did not contain bacteria. A fistula of the lamina papyracea was not disclosed.

Uneventful recovery ensued and the patient was dismissed on February 7. An x-ray examination on February 24, 1938, showed a fairly normal appearance of the maxillary sinus and the ethmoid cells. The boundaries of the left frontal sinus were indistinct and the adjacent bone was sclerotic. The bony septa of the frontal sinus were absent. The lamina papyracea seemed to be normal.

Comment: In this case there was a large pyocele of the frontal sinus which had caused an absorption of the floor of the frontal sinus and a thickening and sclerosis of the anterior and lateral walls of the sinus and of the frontal septum. The nasofrontal duct was obliterated. This finding is typical. In the presented case, however, the displacement of the eye was not caused by the pyocele of the frontal sinus but by a cyst-like sac, which was situated between the frontal mucosa at the floor of the frontal sinus and the periosteum of the orbit and had no connection with the nasofrontal duct. The sac was filled with pus and bulged into the frontal sinus, particularly into its lateral recess. Toward the orbit the cyst-like sac became narrow and ran toward the posterior part of the lamina papyracea. It had no communication either with the nose or the frontal sinus.

It is difficult to offer a satisfactory diagnosis concerning the cyst-like sac. A meningocele does not come into consideration. An orbital cyst, which is a rare finding, contains a serous and not a purulent fluid, is not attached to the lamina papyracea, and is situated within the periorbit and not between bone and periorbit. An old, encapsulated periosteal abscess of the orbit likewise does not come into consideration because there never was an inflammation of the orbit. Under these circumstances one must assume that the cyst-like sac was due to a transformation of a pneumatic cell, the opening of which became obliterated and the bony walls absorbed. The surgical findings indicate that the pneumatic cell has been an ethmoidal cell which extended deeply into the roof of the orbit and became dilated by the formation of a pyocele within the cell. Granted that this concept is correct it is evident that the patient had a pyocele of the left frontal sinus which caused an absorption of the floor of the sinus and a sclerosis of the other walls and a pyocele of an orbital cell which caused a dilatation of the cell and an absorption of its bony wall. The displacement of the eye was caused by the pyocele of the orbital cell.

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LXXV

MUCOCELE OF THE FRONTO-ETHMOID AREA

REPORT OF TWO CASES

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Two cases of mucocele of the fronto-ethmoid area are being reported with a review of the literature.

Skillern[9] describes a mucocele as a collection of mucous secretion within a sinus resulting from obstruction to drainage, with ultimate distention of the walls of the cavity. Mucoceles of the maxillary and sphenoid sinuses have been reported but involvement of these two sinuses is uncommon. The most frequently affected are the frontal and anterior ethmoid sinuses.

The two patients whose cases are here reported complained of disturbances around the eye.

CASE 1.—A. D., aged 56, was admitted to St. Mary's Infirmary December 16, 1946, complaining of inability to see and of a pimple over the left cheek.

The present illness began two years ago when a pimple near the inner canthus of the left eye continued to increase in size and resulted in almost a complete closure of the lower lid. The patient further complained of fullness and pressure around his left eye.

The patient denied any history of trauma, headaches, nasal obstruction, nasal discharge, frequent colds or any other disturbances of the sinuses.

Examination revealed a large bulging mass, five cm. square, on the left side of the face, protruding around the bony surface and extending from the infraorbital ridge to one inch above the gingivolabial fold, medially to the inner canthus and the nasal bone and laterally to the malar surface of the zygomatic bone.

The most obvious diagnosis of such a mass is cancer of the maxillary sinus.

Further examination disclosed the mass to be semisolid and fluctuant in certain areas, particularly around the borders. The mass could be clearly outlined against the bony ridge of the superior maxilla which yielded to pressure. No pain, tenderness or proptosis was elicited. The left eye was degenerated.

Nasal examination revealed no obstruction, discoloration or bulging of the lateral nasal wall. This was equally true of the opposite side of the nasal cavity. Postnasal examination was essentially negative for abnormal secretions or masses.

The x-ray report revealed the maxillary sinus to be somewhat obscured, probably due to exudate, but there was no evidence of bone destruction.

One day later lipiodol was instilled into the maxillary sinus under the inferior turbinate. Immediately after the puncture, a large amount of thick, brownish fluid returned. When the fluid had discontinued, lipiodol was again instilled and another roentgenogram was made. The results were as follows:

The medium was in the lower portion of a cyst and a definite fluid level was seen above it; there was no evidence of the medium being in soft tissue.

The ophthalmologist reported optic nerve atrophy of the left eye—diffuse superficial keratitis; bilateral optic nerve atrophy, complete on the left, partial on the right. The laboratory reported the Kahn test negative; red blood cells, 4.40; white blood cells, 6,000; differential, normal.

An exploratory operation was scheduled on December 24, 1946, under intravenous anesthesia (sodium pentothal). A horizontal incision was made directly over the mass extending laterally to the zygomatic arch. A large cystic mass was found with thick, brownish colored fluid flooding the operative field with a force indicating it had been under intense pressure. The sac was dissected out from over the bony parts extending to the zygomatic arch laterally. All of the bony infraorbital ridge had been completely eroded; medially the lamina papyracea was absorbed to such an extent that the postnasal space could be visualized through the opening; all mucosa lining this sac was removed. This deep cavity was packed with iodoform gauze, the end of which extended out of the nasal cavity through the middle meatus around which was placed a dark string for identification.

Following this procedure a Caldwell-Luc operation was performed on the same side. The mucosa was thickened and the antrum was of the infantile variety. No polyps were observed. There was no connection between the sinus (antrum) and the mucocele directly above the antrum. A window was placed under the inferior turbinate, a strip of ribbon gauze saturated with sterile vaseline and sulfathiazole powder was placed in the antrum covering all sides, the end extending out of the window into the nasal cavity.

The pathologist reported a diagnosis of chronic inflammation, which is the usual report in these cases.

CASE 2.—C. S., aged 56, was admitted to St. Mary's Infirmary in April 1945 with a chief complaint of "watering of the eyes." The patient gave a history of nasal obstruction, headaches and frequent antrum irrigations.

Physical examination revealed a protruding mass over the inner canthus on the right extending laterally to the supraorbital foramen, with partial occlusion of the eye but no displacement of the eyeball. This mass which was fluctuant could not be clearly outlined around the bony area; there was no pain or tenderness.

The nasal mucosa was dry and scaly with an apparent tendency to atrophy.

The x-ray film revealed opacity involving the right frontal, ethmoid and both maxillary sinuses.

The impression was sinusitis.

The laboratory report was essentially negative.

A radical fronto-ethmoidectomy was done. A Lynch incision exposed a large amount of thick, yellowish, nonodorous secretion and uncovered a cystic membrane. The cystic membrane was dissected out and the bony overhangs were removed. The lamina papyracea was destroyed by the cyst along with the floor of the frontal sinuses. A cigarette drain was placed from the sinus into the middle meatus with the end extending out of the nasal cavity. The patient made a rapid recovery with no further disturbance.

DISCUSSION

The first symptoms in these two cases of mucocele were related to the eyes: in the first, decrease in vision and in the other, epiphora; therefore, the first physician to see many of these cases is the ophthal-

mologist. All patients with pressure symptoms around the inner canthus should have an x-ray examination for possible involvement of the ethmoid sinus, even though the x-ray study was of no positive value in these two cases until the incision was made.

In the earlier stages all symptoms may be lacking, as the growth usually takes place painlessly, and not until marked swelling occurs, does the patient pay any attention to this condition. During the later stages a hard, bony distention may be encountered that may confuse the clinician by its great similarity to malignant growths of the paranasal sinuses.

The parchment-like crackling due to partial absorption of the bone should lead one to suspect a mucocele.

Gummas, aneurysms, fibromata, angiomata, lymphoid tumors, meningoceles, chronic sinusitis should be kept in mind.

Morrison[4] states that the closure of the normal opening of the sinus for very long periods allows the slow collection of thick, viscid material which results in cystic formation. Skillern further states that trauma to tissue, closed empyema and extension of the local inflammation should be given as the possible etiological factors.

The literature is replete with cases that follow the usual course of destruction of the lamina papyracea, bulging along the inner canthus, proptosis, and swelling over the supraorbital area. At times the lateral nasal wall may show bulging into the nasal cavity. The second case may be considered one of the many, but the first case reveals no such typical findings.

This case is of interest because of the extensive involvement of the ethmoid and frontal sinuses, the extension of the mucocele laterally and the failure of the roentgenogram to reveal properly the extensiveness of the mass until lipiodol injection and an exploratory incision were made.

This confirms the opinion of numerous observers that the diagnosis and treatment of mucocele will have to be made clinically rather than by x-ray and pathological study.

The two cases here reported revealed after extensive removal of the sac walls only evidence of chronic inflammation as reported by the pathologist. Both patients have fully recovered and have shown no further symptoms or physical findings.

Hardy[10] states that cysts contain a thin fluid; mucoceles, a thick material. Both are lined by cuboidal or columnar epithelium.

Finally Weiss[1] states that the walls of a mucocele show pressure changes. The mucosa is thickened, then the columnar epithelium may be flattened, the cilia deficient or absent. The sac contains tenacious, viscid, gelatinous, mucoid, yellow or greenish-brown fluid, desquamated epithelial cells, leucocytes, fat cells, rarely cholesterol.

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LXXVI

THE PREVENTION OF RECURRENCE OF NASAL POLYPS

A COMPARISON OF RESULTS OF THE POSTOPERATIVE USE OF RADIUM AND ZINC ION TRANSFER

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Removal of nasal polyps is a frequent surgical procedure. Every rhinologist has had the experience of performing several, sometimes many, operations on the same patient. Whether polypoid regrowth is the result of incomplete extirpation, or of an untreated or uncured existing inflammatory process or allergy is not to be argued here. Suffice it to say this problem remains controversial and only additional research will settle it. It is a common observation, however, that nasal polyps recur even after radical operation on the nose and paranasal sinuses. If we assume that there is a relationship of the allergic factor, we must take cognizance of the fact that allergic therapy has not demonstrated any marked influence on the prevention of the regrowth of nasal polyps. Their recurrence is not only distressing to the patient but annoying and often embarrassing to the rhinologist. It is, however, unfair to inform the patient that nothing can be done without trial of some of the more recently advocated procedures.

In a previous article on this subject I[1] discussed and evaluated three different methods for preventing regrowth of nasal polypoid tissue. These methods included: electrosurgery, radium therapy, and zinc ion transfer. All of these have been effective in selected cases and each seems to possess certain virtues not possessed by the others. For example, electrodesiccation is a successful means of retarding the regrowth of polyps if the pedicles of the growths are accessible. When the polyps are of the massive type, a more generalized plan is essential if recurrence is to be prevented. It is well known that radium application has afforded favorable results in many of these cases. Though quite a few rhinologists have adopted the postoperative use of radium as a more or less routine procedure, a large number have failed to avail themselves of this improved treatment. In fact, some rhinologists are still unfamiliar with it, while others object to the cost of renting the radium. These may be the reasons why

in some quarters the recurrence of nasal polyps remains an unsolved problem.

For purpose of clear understanding, it should be mentioned that the extirpation of polyps is best performed by the classical surgical techniques. The problem under consideration is how to prevent the necessity of repeated operations. As previously mentioned, radium therapy possesses definite merit for this purpose. While the techniques vary with different clinicians, in the main they are quite similar. I have used the technique suggested by Scal[2] because of its simplicity and because no harmful effects have been observed over a period of more than two years. The procedure consists of applying a 50 mg. capsule of radium, screened by a platinum container encased in gutta-percha. The capsule is placed against the operated area in the nasal chamber for three hours. Each nasal chamber is treated separately, although both chambers may be treated simultaneously if two capsules of radium of 25 mg. each are available. In fact, some radiologists advocate the latter plan. As a general rule, two to three treatments are necessary, and they should be given at intervals of two to three weeks.

With postoperative radium therapy the regrowth of nasal polyps may be prevented in approximately 70 per cent of the patients. Despite such success from a scientific point of view, the method is by no means an economical one for the patient. The rental of radium, especially when several treatments are required, is fairly expensive and often beyond the means of the average patient. In clinic or dispensary practice, unless the institution owns its own radium, the cost of radium rental frequently renders it impossible for the patient to be given the benefit of postoperative treatment. Also, in some areas, radium is not easily available, or, if it is, there is occasionally apprehension on the part of the rhinologist in applying it unless he has had some previous experience with radium therapy. These facts prompted me to seek some substitute method which would be at least as effective as radium without some of the shortcomings mentioned. Experience with zinc ion transfer has demonstrated that this is the ideal procedure for the purpose.

This is not a new method, though it is a new name. It was formerly called zinc ionization or zinc iontophoresis.[3] The controversial aspects of the procedure will not be discussed here. For the pathologic process for which zinc ion transfer is here advocated, all arguments *contra* are invalid. If radium can be employed as a postoperative weapon to prevent recurrence of polyps, zinc ion trans-

fer, much less destructive as a local agent, certainly should find no objections to its use. Moreover, what injury or harm can be done to a nose in which massive polyposis has occurred and in which practically all the tissue has become hyperplastic? On scientific grounds the answer must be none.

It is assumed, of course, that before the ion transfer method is applied, surgical extirpation of all accessible polypoid tissue has been done. After two weeks have been allowed for healing, zinc ion transfer is applied. Both nasal chambers may be treated at the same sitting.

The immediate reaction is a stuffy nose with an excess of secretion. This reaction, however, is not severe and usually lasts for a brief period—24 to 48 hours. In a few instances an anodyne may be required, but in no case is the effect severe. The treatment should be repeated in two to three weeks. Rarely is a third treatment necessary.

In a comparison of results of the postoperative use of radium and zinc ion transfer, it was found that they closely approach one another. In 65 patients treated postoperatively with radium, the recurrence of nasal polyps was completely prevented in 47 and partially prevented in 18. In 72 patients treated postoperatively with zinc ion transfer, recurrence of polyps was definitely prevented in 55 and partially in 10. In 7 the treatment failed to produce the desired effect.

When there was recurrence of nasal polyps, the interval of regrowth was much longer when either radium or zinc ion transfer was used, and at no time was obstruction a prominent symptom.

Of 22 patients who had been subjected to specific immunization, preoperatively and postoperatively, 18 had a recurrence of polyps within two to six months. These results are given to point out the ineffectiveness of allergic therapy in preventing regrowth of polyps despite the favorable claims of some allergists. It may be true that nasal polyps very often represent an allergic condition of the mucous membranes, but as Urbach[4] has pointed out this is a result and not a cause of rhinopathy, and, therefore, one must not be surprised to see that polyps, once removed, frequently reappear.

Comment. It is not inappropriate in a discussion of therapy to review the general beliefs concerning the pathology of polyps. The fact remains, however, that the problem is still controversial. Some allergists, as for instance Duke,[5] found polyps in 24 per cent

of a series of patients with perennial nasal allergy. Others emphasize that polyps are common in asthmatics. Whether polyps are due to allergy or to some other cause is the main topic in controversy. The mucous nasal polyp has been attributed invariably to allergy by Kern and Schenck,[6] and they suggest the cause is bacterial. In fact, they contend that bacterial allergy is the usual mechanism in polyp formation.

Some writers have expressed the opinion that polyps should not be removed unless they are fibrotic. However, from a rhinologic point of view the absolute indication for extirpation is nasal obstruction. When polyps produce symptoms, such as blocking of the nasal airway, their removal is imperative, irrespective of the type of polyps present. Furthermore, the method to be employed for producing an adequate airway should be the one whose effect is immediate. Only surgical extirpation affords such a result. Once removed, the problem is to prevent recurrence of the polypoid growths.

It is stressed that neither radium nor zinc ion transfer is intended as a substitute for surgical extirpation. The purpose of applying one or the other of these agents is merely to prevent the regrowth of polyps and thus obviate the necessity of frequent operative intervention. If the source of the polyps is in one or more of the paranasal sinuses, obviously radical sinus surgery may be the indicated initial procedure.

Some time ago I[7] published a paper dealing with the controversial aspects of zinc ion transfer. In this paper I pointed out that condemnation of zinc ion transfer in the nose is unjustified, as such an attitude is assumed from reading prejudiced reports and not from personal experience with the method. I want to emphasize this statement and to state again that the claims of certain authors that zinc ion transfer produces severe reactions, anosmia and harmful permanent effects on the nasal mucosa have not been borne out in an experience of several thousands of treatments.

SUMMARY AND CONCLUSIONS

1. Nasal polyps recur frequently even after radical extirpation.

2. Of the postoperative physical methods employed to prevent recurrence of polyps, electrosurgery, radium therapy and zinc ion transfer have been found effective in a large precentage of patients.

3. While radium therapy and ion transfer are equally effective, the former is a more costly method and not always easily available.

4. The results of zinc ion transfer compare favorably with the results of radium application in preventing the recurrence of nasal polyps.

5. Neither radium nor zinc ion transfer is intended as a substitute for surgical extirpation, but merely as a postoperative procedure.

6. The claims of certain authors that zinc ion transfer produces severe reactions, anosmia and other harmful effects are prejudiced and have not been borne out in several thousands of treatments.

7. For the purpose for which it is here being advocated zinc ion transfer is a gratifying addition to the rhinologist's armamentarium.

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LXXVII

LUDWIG'S ANGINA—A SURGICAL APPROACH BASED ON ANATOMICAL AND PATHOLOGICAL CRITERIA

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CINCINNATI, O.

Wilhelm Friedrich von Ludwig[1] in an address to his colleagues in 1836 called attention to a very severe and, as he believed, new type of inflammation of the neck and floor of the mouth. His original article, published in the local medical journal of Stuttgart, is simply signed "D. Ludwig" and has no title. This fact is mentioned because of some erroneous quotations occasionally occurring in later literature.

In spite of Ludwig's masterly description of his observations and findings in five instances of the disease, called since then by his name, there still exists considerable confusion over the question of what is and what is not Ludwig's angina. The original article clearly presents the characteristics by which the "gangrenous inflammatory induration of the connective tissue of the neck" is differentiated from other inflammations of similar location and appearance. The latter were designated as "pseudo-Ludwig's anginas" by the author[2] in a previous article.

Differentiation of Ludwig's angina from pseudo-Ludwig's angina is based on the following:

1. Ludwig's angina is a cellulitis—not an abscess.

2. It starts regularly in the submandibular space—not in the sublingual space.

3. It involves both spaces, usually bilaterally—never one single space.

4. It produces gangrene with a serosanguineous putrid infiltration—but very little or even no frank pus.

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This paper, except for some changes and additions, was read by title at the Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology, Chicago, Ill., October 18-19, 1946.

Fig. 1.—Perforation of the inner plate of the mandible below the mylohyoid ridge at the site of the second molar tooth.

5. It attacks the connective tissues, fasciae, and muscles—not the glandular structures.

6. It spreads by continuity—not by the lymphatics.

While the clinical and pathological pictures were well established, the pathogenesis and the treatment of the disease remained an open question.

Ludwig's original impression of the disease as an "epidemic of erysipelatous nature" was gradually disproved. The role of the molar teeth as the chief pathogenetic factor was fully recognized only after several decades. As an explanation the allegedly smaller thickness of the inner plate of the molar alveoli was assumed to be responsible for occasional perforations of molar root abscesses on the lingual side rather than on the buccal side. This theory, offered first by Moty[3] in 1892, was generally accepted until disproved in 1943 by anatomical studies of the present author.[2] It was shown that there exists contrary to the above-mentioned assumption quite an irregularity in the thickness of the inner and outer plates, the inner even frequently being thicker. In addition, it was shown that the roots of the molar teeth, particularly of the second and third ones, as a rule extend as far as or even beyond the mylohyoid ridge, while the roots of the anterior ones never reach so far. Consequently, in the case of perforation of the alveolus by an abscess of the second or third

(and rarely the first) molar root on the lingual side the infection necessarily encroaches on the submandibular space where Ludwig's angina regularly starts (Fig. 1).

Although surgery had been used in rare instances for the treatment of Ludwig's angina even before the time of Ludwig,[4] it was not regarded as the routine therapeutic procedure before the last quarter of the nineteenth century. A considerable variety of approaches was used and, even at the present time there does not exist a generally accepted standard method.[5] Median longitudinal incisions as well as transverse ones and combinations of both are equally advocated, including cutting of various muscles in different ways and even total removal of the submaxillary salivary gland. Necessity for surgical intervention is now considerably reduced because of modern chemotherapeutic and antibiotic treatment. However, there still remains a number of cases where only the surgeon's knife may provide the life-saving factor. Out of five cases of Ludwig's angina (cases of pseudo-Ludwig's angina are not included) observed in the Cincinnati General Hospital over a period of two years, surgery became necessary in three instances in spite of the early administration of sulfonamides and penicillin.

It might be justifiable to present a procedure which is based on anatomic studies in line with the pathological conditions outlined above. This technique is illustrated by a series of photographs taken at various dissections.

Release of tension is the basic principle in operations for Ludwig's angina. Search for pus, which is sometimes not even found at autopsy, may be a misleading idea.

Two structures are chiefly responsible for tension. The one is the strong suprahyoid fascia covering the three inframylohyoid spaces, the right and left submandibular spaces and the submental space between them. The other one is the mylohyoid muscle covering the two supramylohyoid spaces, the right and the left sublingual space. The maximum release of tension can be effected only by dividing these two structures at right angles to the course of their individual fibers. This course, however, is entirely different for the fascia and the muscle since the fascia extends in a longitudinal direction, the muscle in an almost transverse one.

A skin incision is made on the side of the major involvement at the level between the upper and the middle third of an imaginary line between the chin and the thyroid notch, from a point half an

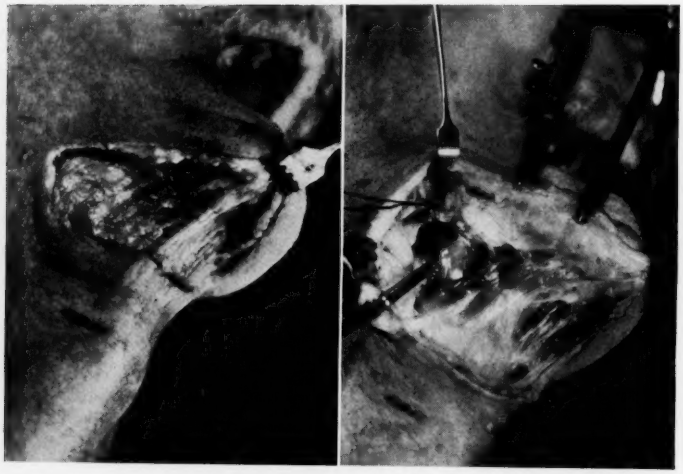

Fig. 2.—Skin incision and exposure of the suprahyoid fascia.

Fig. 3.—Ligature of the submental branch of the facial artery. A probe is placed under the mylohyoid muscle.

inch inside the angle of the mandible and extending transversely to a point beyond the midline. This level corresponds to a line half way between the upper and lower attachments of the suprahyoid fascia. Since possibly the hyoid bone cannot be identified through the board-like swelling, the thyroid notch which usually is still palpable is chosen as a point of orientation.

The suprahyroid fascia and the platysma muscle are next exposed (Fig. 2). When water is experimentally injected into the submandibular space, it spreads and a remarkable ballooning of the latter occurs with ready extension into the submental space beyond the midline. Thus the manner in which cellulitis located in one of the spaces rapidly spreads into the adjacent one is demonstrated.

The suprahyoid fascia is then cut transversely beyond the midline and freed from its underlying attachments. The submental branch of the facial artery is exposed and ligated (Fig. 3). Ligature of the facial artery can be avoided in this procedure. The fascia of the submaxillary salivary gland is freed at the angle between the digastric bellies from its intimate attachments and the gland is retracted laterally.

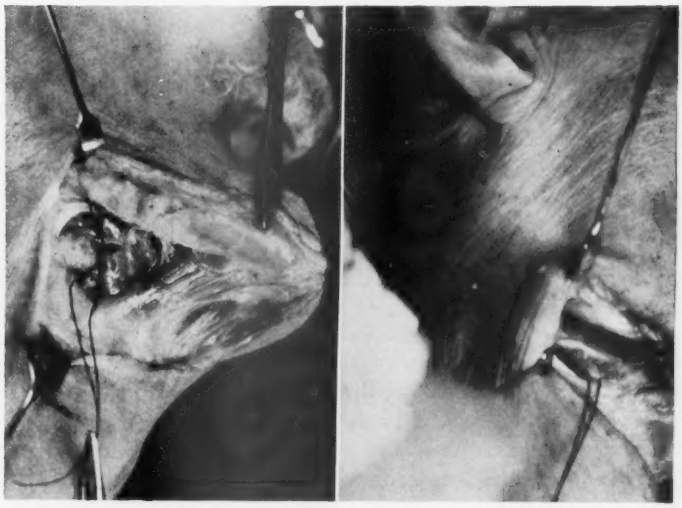

Fig. 4.—The lingual artery is exposed in the lingual triangle and a loop of silk is placed around the vessel.

Fig. 5.—Note the wide gap obtained after cutting the mylohyoid muscle as described.

Thus the triangle of the lingual artery (trigonum linguale) with the underlying portion of the hyoglossus muscle is exposed. This triangle is formed, according to Zuckerkandl,[6] by the border of the mylohyoid muscle, the tendon of the digastric muscle and the hypoglossal nerve. This seems to be a more accurate description of the triangle than that which refers to it as "Lesser's triangle."

The lingual vein crossing the hypoglossal nerve may be ligated. If necessary, exposure of the lingual artery is easily performed at this site by separating the fibers of the hyoglossus muscle. The lingual artery is pulled forward and a loop of silk is placed around it (Fig. 3). This procedure may occasionally be helpful in readily controlling a hemorrhage due to arrosion of a branch of the lingual artery.*

The division of the mylohyoid muscle is performed perpendicularly to the course of its fibers. The importance of transverse di-

*As generally known, George Washington died of an uncontrolled hemorrhage which occurred in the course of a deep neck infection (cynanche cervicalis).

vision of this muscle has been repeatedly mentioned in the literature and was first emphasized by Schlesinger.[7] The present study shows that the anterior belly of the digastric muscle may serve as a useful guide indicating the direction of the cutting. A grooved director is placed under the mylohyoid muscle in a direction nearly parallel with the anterior belly of the digastric and about half an inch lateral to it (Fig. 3). Cutting the mylohyoid muscle in this way is followed by the immediate appearance of a wide gap between the two segments (Fig. 5).

A small gap appears when the mylohyoid muscle is divided along the course of its fibers instead of transversely to them.

The mucous membrane of the floor of the mouth may or may not be divided depending on the degree of tension. Objections to this procedure with regard to the possible aspiration of pus (which in Ludwig's angina is usually absent), or contamination of the wound (which is severely contaminated anyhow) appear unjustified. Contrariwise, spontaneous rupture into the sublingual sulcus which occasionally occurs is to be welcomed. Moreover, endoral incisions of peritonsillar, alveolar, retropharyngeal, and even laryngeal abscesses are procedures well tolerated and generally accepted. In particularly severe cases the possibility of bipolar drainage as provided by perforation of the oral mucosa may even be advantageous.

Certain procedures should be avoided. Cutting the digastric and geniohyoid muscles and removing the submaxillary salivary gland, as advocated by some men, should be omitted. Tension of these muscles is only secondary to the tension of the underlying mylohyoid muscle, approximately comparable to the tension of strings placed around a balloon when it is blown up. When the balloon is collapsed by a perforation, the tension of the strings is released equally.

Moreover, the anterior bellies of the digastrics and the geniohyoids are of great importance in opening the mouth and supporting the hyoid bone and thus the larynx. Impairment in opening the mouth and laryngeal ptosis with its untoward sequelae may be caused by severance of these muscles. The submaxillary salivary gland is not included in the inflammatory process, as was repeatedly emphasized in Ludwig's original article and proved by the gross and microscopic examinations of Coplin.[8] Accordingly, there is no reason for extirpation of this structure. Its fascia, however, should be freed at the sites of its attachments to the surrounding structures,

particularly at the lower pole. Thus formation of pockets interfering with free drainage may be prevented.

The same procedure may be done if necessary on the other side and rubber drains placed.

Up to the present time two patients with Ludwig's angina have been operated on at the Cincinnati General Hospital, according to the described method, with very good results. In the first case, however, an emergency tracheotomy preceded the operation. The second patient was operated on only recently. He is now convalescing. This case is of particular etiological interest since Ludwig's angina developed subsequent to an incision of a peritonsillar abscess. It will be reported on later.

Choice of anesthesia and its mode of application deserve particular consideration. Asphyxiation is the most frequent cause of death in Ludwig's angina. It may be due to obstruction of the air passages or to impairment of the nerve mechanism controlling the respiration.

The former needs no comment. The latter was already recognized by Ludwig when he said in his classic description: "Dyspnea with anxiety occurs usually in paroxysms with intervals of normal breathing. This fact as well as the increase of dyspnea even when tension in the neck appears diminished, suggests that these phenomena are not caused by mechanical obstruction of the air passages but result from an involvement of the nervous system. . . . Death occurs in a state of coma with signs of respiratory paralysis."

Numerous reports of respiratory paralysis in cases of Ludwig's angina are on record. Cessation of breathing, particularly when the general anesthesia is started, has occurred in these cases. One instance occurred sometime ago in the Cincinnati General Hospital. The patient stopped breathing when the laryngoscope was introduced by force for insertion of the endotracheal anesthesia tube. No edema or swelling of the upper air passages was present.

It is assumed that these accidents are caused by paralysis of the medullary respiratory center. Two components are to be regarded as the responsible factors. One is the acapnia caused by hyperventilation due in turn to persistent shallow and rapid respiration. The other is the hypersensitivity of the carotid sinus pressure receptors caused by the adjacent inflammatory process. This has been proved by Weese[9] in animal experiments by means of artificially produced inflammations in the area of the inner carotid triangle. In these ani-

mals pressure on the carotid sinus on the affected side, produced while the animal was under superficial anesthesia, was followed by irreversible apnea. This, however, was not the case under deep anesthesia or with pressure applied on the unaffected side. This was observed about equally in inhalation and intravenous anesthesia.

By these experiences and experiments the following conclusions appear to be justified with regard to Ludwig's angina:

1. Early tracheotomy is imperative whenever breathing appears shallow and rapid, regardless of the absence of audible or visible signs of mechanical obstruction. The great number of emergency tracheotomies necessitated in Ludwig's angina should be regarded as a warning.

2. Application of inhalation anesthesia should be made exclusively through a tracheotomy wound, since introduction of the laryngoscope by force may cause the catastrophic stimulation of the carotid sinus.

3. Any manipulations, even preoperative preparations, at the site of the inner carotid triangle are to be done before anesthesia is started or only until deep anesthesia is achieved. In intravenous anesthesia at least five minutes following the injection are required, according to Weese.[9]

4. Topical anesthesia is the preferred procedure since it may prevent stimulation of the carotid sinus reflex. However, even then one has to be cautious. Sometimes even in local anesthesia the carotid sinus may be stimulated, by pressure caused by the infiltration, according to Williams and Marcus.[10]

SUMMARY

Characteristics, significant for the differentiation of Ludwig's angina from pseudo-Ludwig's angina are listed.

Release of tension but not search for pus is the goal of any operative procedure in Ludwig's angina.

The suprahyoid fascia and the mylohyoid muscle are the main factors responsible for tension in the inframylohyoid and supramylohyoid spaces.

Operative procedure has as its purpose the most effective division of these two structures. This is achieved by cutting in a direction perpendicular to the course of the fibers extending between the

lines of their attachment. The method is described in its separate steps and illustrated by photographs.

Experimental injection of fluid into the submandibular space in a cadaver illustrates by its rapid diffusion into the submental space the analogous condition in cellulitis of these spaces.

Attention is called to the danger associated with too superficial general anesthesia in these cases since the carotid sinus reflex due to hypersensitivity of the nerve elements at the bifurcations thus may easily be elicited. Local anesthesia is the least dangerous procedure. The importance of early tracheotomy in order to prevent acapnia is emphasized.

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LXXVIII

THE USE OF SULFAMYLON IN RHINOSINUSITIS

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Early in 1946 a study was undertaken of the effects of a relatively new sulfonamide, sulfamylon, in infections of the nose and accessory sinuses. Later the combination of sulfamylon and neosynephrin hydrochloride was studied in the same types of cases. To date more than 200 cases have been treated with these preparations.

Sulfamylon is 4-aminomethylbenzenesulfonamide hydrochloride, with a molecular weight of 222.67. It is a white crystalline material which is freely soluble in water. Its aqueous solutions are weakly acidic, a 1% solution having a pH of 5.5 and a 20% solution having a pH of 5.1.

Chemically this compound differs from sulfanilamide in that a methylene group has been inserted between the benzene ring and the 4-amino group. Because of the presence of this methylene group in its molecule, the antibacterial activity of sulfamylon is not inhibited by p-aminobenzoic acid, and its mode of action probably differs from that of the commonly used sulfonamides. This has been confirmed by several investigators.[2-6]

When given orally to dogs, sulfamylon is rapidly deaminated and oxidized in the body to p-carboxy benzene sulfonamide, which is excreted in the urine. The process is rapid, so that for three to four hours the urine is heavily loaded with the material, but 24 hours after a single dose of sulfamylon, the urine is practically free of the excretion product.

Sulfamylon is effective against both the anaerobes and the aerobes. It is especially effective against infections caused by the gas gangrene group of anaerobic bacteria. Brewer[1] showed that a 1% solution of sulfamylon was more effective, in vitro, against the Clostridium welchii, Clostridium chauvei, Clostridium septicum, Clostridium botulinum, Clostridium histolyticum, Clostridium tetani and Clostridium novyi than comparable concentrations of the sodium

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salts of sulfadiazine and sulfathiazole. In fact, his investigations showed that while sulfamylon was bactericidal to all the organisms tested, sufadiazine was active only against Clostridium welchii and Clostridium novyi, and sulfathiazole against Clostridium welchii, Clostridium novyi and Clostridium tetani. Furthermore, dilution studies revealed that sulfamylon was effective against Clostridia at dilutions as great as 1:25,000 while even a 1:100 dilution of sodium sulfathiazole was comparatively ineffective. Lawrence[2] confirmed these results and stated that sulfamylon is bacteriostatic to anaerobic bacteria in dilutions of 1:32,000 to 1:64,000, and bactericidal in dilutions of 1:400 to 1:32,000.

When tested against various aerobic organisms, Brewer[1] found sulfamylon effective against Streptococcus hemolyticus, Streptococcus viridans and Pneumococcus types I, II and III at dilutions of 1:12,800; whereas it inhibited the growth of Staphylococcus aureus and Pseudomonas aeroginosa (Bacillus pyocyaneus) at dilutions of about 1:1600. It was ineffective against Escherichia coli even in concentrations of 1:400.

Lawrence[2] substantiated these findings and proved that sulfamylon was fully as effective against Streptococcus hemolyticus and Pneumococcus types I, II and III as sodium sulfathiazole and considerably more active than sodium sulfadiazine. Sulfamylon was definitely bacteriostatic and bactericidal to Streptococcus viridans and showed some inhibitory action on Streptococcus faecalis, whereas the other sulfonamides gave no suggestion whatever of antibacterial action against these organisms.

The toxicity of sulfamylon has been studied by oral, subcutaneous and intraperitoneal administration of the drug to mice, and oral administration to rats, rabbits and dogs.[11] No albuminuria or hematuria was observed and the results of phenolsulfonphthalein kidney tests were negative. Autopsy revealed no significant gross changes, and histologic study of the kidney, liver, stomach and intestines of dogs was essentially negative.

Studies were carried out to determine the local tolerance of mucous membrane to sulfamylon. Solutions of sulfamylon of 0.1, 0.5, 1.0 and 2.0% were tested for possible irritation to the conjunctival mucosa of rabbits, and no evidence of irritation could be found even after repeated applications of the above concentrations.[11, 12] In addition, daily urinary bladder irrigations were performed on rabbits with solutions of sulfamylon ranging in concentration from 1% to 20%. Approximately four hours after the

fifth irrigation, the animals were sacrificed and the bladder mucosa inspected and found entirely normal in every case.[11]

Later, Beyer[7] reported his experience with a mixture of sulfamylon and sulfanilamide (in the proportion of 1 to 9) as a prophylactic in 60 patients with fresh wounds and as a direct antiseptic in 140 patients with infected wounds. Healing was uneventful in every case. Other reports in the literature have attested to the clinical value of sulfamylon against specific anaerobes in wounds.[8-11]

Recently, Howes[12] investigated the relative effectiveness and tissue toxicity of streptomycin, sulfamylon, calcium penicillin, parachlorophenol, tyrothrycin and zephiran in tissue cultures and wounds. He concluded that, "For local chemotherapy sulfamylon, 5 per cent, seems to be superior to the six other antibacterial substances tested. It possesses the widest range of antibacterial activity and is relatively nontoxic. It is active in the presence of pus and blood and is not affected by changes in the acidity of the environment. It possesses rapid bactericidal activity. . . . Streptomycin is next best. . . . Penicillin is placed third. . . . Tyrothrycin, parachlorophenol, and zephiran have a toxicity which permits their use only on granulating wounds."

It has not been possible to study the systemic effects of sulfamylon on infections in humans as there is as yet no known chemical method of determining the blood concentration of the drug. All studies have therefore been limited to its use locally in wounds, and now in this study it has been used in the nose and accessory nasal sinuses.

Clinical Investigations. Early in 1946 a clinical investigation was undertaken of the effects of the local use of sulfamylon in rhinosinusitis. Prior to this time solutions of the sodium salts of sulfathiazole and sulfadiazine had been used, as well as a solution of sulfadiazine in ethanolamines, and combined solutions of sodium sulfathiazole with dexoxyephedrine. Also, solutions of penicillin had been employed in various concentrations.

The first cases treated with sulfamylon were those of suppurative sinusitis with empyema of the antrum, in which antral irrigation via the natural orifice was followed by instillation of 1% solution of sulfamylon into the affected antrum. The results were excellent, surpassing the results being obtained by analagous therapy with the other solutions mentioned above.

Later some cases of subacute and chronic suppurative rhinosinusitis were treated locally by repeated atomizer applications of a 1% solution of sulfamylon, and the results were also quite encouraging. However, it was often necessary to prescribe a vasoconstrictor for simultaneous use in these cases, as sulfamylon has no vasoconstrictor properties per se.

A combination of sulfamylon, 1%, with neosynephrin hydrochloride, ¼%, was then made available and was found more useful than the solution containing 1% sulfamylon alone. Still later a 4% solution of sulfamylon was tried but was not found to be more effective than the 1% solution.

In all, sulfamylon was employed in more than 200 cases of rhinosinusitis, in 137 patients. In no case of simple coryza ("common cold") was the drug prescribed. Clinical evidence of nasal or sinus suppuration was a prerequisite before the drug was used. Cultures were taken in approximately one half of the cases and revealed the presence of the following organisms:

Streptococcus viridans

Staphylococcus aureus (nonhemolytic and hemolytic)

Staphylococcus albus (nonhemolytic and hemolytic)

Bacillus aerogenes

Bacillus proteus

Pseudomonas aeroginosa (Bacillus pyocyaneus)

Diplococcus pneumoniae (types undetermined)

In early acute rhinosinusitis and in cases without antral involvement, the combined solution of sulfamylon, 1%, and neosynephrin, ¼%, was prescribed for home use by atomizer spray every 2 to 4 hours, according to the severity of the case. In children, drops were prescribed according to age.

In cases of antral empyema, irrigation was carried out via the natural orifice (whenever possible) with physiologic sodium chloride solution to cleanse the antrum completely of all visible pus or mucopus. The saline solution was then evacuated by instillation of air, and sulfamylon solution (1% or 4%) was instilled so as to fill the antrum as completely as possible. The cannula was then removed and the patient warned not to blow the nose for several hours. The combined solution of sulfamylon and neosynephrin was then pre-

scribed for home use as a spray every two to four hours for 48 hours, when the antrum was again irrigated and sulfamylon solution instilled.

In every case there was marked improvement noted at the time of the second irrigation, and rarely was any pus found on the third irrigation 48 hours later. (In all cases irrigations were done every 48 hours until the antral washings returned clear, and then, in most cases, one more antral irrigation was carried out 48 hours later as a safeguard against recurrence.) There were three cases of Pseudomonas aeroginosa (Bacillis pyocyaneus) infection of the nose (and one of the middle ear in a patient not reported in this series). Sulfamylon definitely reduced the formation of "green pus" but did not promptly eradicate the infection, although every one of the cases eventually cleared up with persistent treatment with the drug.

In this series there were 53 cases of frank empyema of the antrum, with or without other sinus involvement when first seen. Of this number, 11 had been treated unsuccessfully by irrigation and instillation of a penicillin solution on at least three occasions at 48-hour intervals. In addition, these patients were taking sulfathiazole orally. All of these cases responded promptly to irrigation and instillation of 1% sulfamylon solution, and in no case were more than three irrigations necessary to clear up the infection. In 13 cases the infection was so severe that sulfathiazole or sulfadiazine was prescribed for oral use simultaneously with the antral irrigations, local chemotherapy with sulfamylon, and vasoconstriction. No acute case in this series required any sinus surgery, and every patient made an uneventful and prompt recovery.

It is felt that the above statement should be further explained in the light of the author's opinions regarding the treatment of these cases. It is felt that irrigations through the natural orifice should always be done in preference to antral punctures, especially in early cases. At the same time, it is believed that repeated antral irrigations through the natural orifice are not to be recommended, as trauma to the orifice may lead to some degree of stenosis. Therefore, it has been the author's rule to limit natural orifice antral irrigations to three or four. If more irrigations are necessary, a large antrum window should be made in the naso-antral wall of the lower meatus of the nose. Radical sinusotomy should never be done in acute cases of sinusitis unless complications arise, or until every effort made to clear up the infection by conservative measures over a period of at least several months proves ineffective. It is noteworthy, then, that

since the use of sulfamylon as described not a single antrostomy has been performed in any case of acute sinusitis.

There were more than 20 cases of chronic suppurative rhinosinusitis of long standing. There was a decided improvement in every case following the prescription of sulfamylon solution as a nasal spray, with or without neosynephrin (as seemed indicated). However, several patients had a prompt recurrence of the infection on stopping the sulfamylon spray, even after four or more weeks of continuous treatment. The majority of these had either refused radical surgery of the sinuses and were being treated conservatively at the patient's request, or had secondary atrophic rhinitis where the value of radical surgery was questioned.

No case of drug sensitivity was encountered, even though a number of patients used the drug on several occasions when they suffered repeated attacks of acute sinusitis. The continued use of sulfamylon over a period of ten days or more led to slight secondary injection of the nasal mucosa, but in no case did allergic or vasomotor rhinitis develop, as is so often seen with the preparations of sodium sulfadiazine with or without dexoxyephedrin. Discontinuance of the preparation resulted in prompt recovery of the mucous membrane, so that in 48 hours it appeared normal again. In no case did ulceration or bleeding develop in the membrane. Almost universally, the patients who once used the preparation returned or phoned for more of it when they had another infection of the nose or sinuses, and no patient reported any signs or symptoms of irritation from its use, even though each was questioned carefully.

CONCLUSIONS

1. More than 200 cases of acute rhinosinusitis, in 137 patients, were treated by solutions of sulfamylon or sulfamylon with neosynephrin applied locally in the nose or in the antrum by instillation after irrigation.

2. Cultures were obtained in approximately one half of the cases and revealed the presence of the following organisms: Streptococcus viridans, Staphylococcus aureus (nonhemolytic and hemolytic), Staphylococcus albus (nonhemolytic and hemolytic), Bacillus aerogenes, Bacillus proteus, Pseudomonas aeroginosa (Bacillus pyocyaneus), and Diplococcus pneumoniae (types undetermined).

3. The drug (sulfamylon) proved effective against all of these organisms, exerting its poorest effect against the Bacillus pyocyaneus.

4. It is the author's clinical observation that the drug is more effective against sinusitis than penicillin solutions, and has the added advantage of being stable in solution.

5. No local or constitutional reactions to the drug were noted.

6. In no case of acute sinusitis was surgery required.

7. The author considers sulfamylon the most valuable of the available chemotherapeutic agents in the local treatment of acute rhinitis and sinusitis.

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LXXIX

WOODEN FOREIGN BODY IN THE ETHMOID CAPSULE

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The presence of a common redwood pencil in the ethmoid capsule is reported. It is of interest because of the unique mode of entrance and the fact that it produced few subjective symptoms. It was present in the ethmoid labyrinth and the nose for four months.

A review of the literature fails to uncover a similar case and only a few cases of foreign bodies of the sinuses that are not of metal were found. Voorhees[1] reported a case of a man with a metallic foreign body in the nose for many years which produced morning pain between the eyes. Subbu[2] reported a foreign body in a sinus of a girl for five years which produced a rhinolith, swelling of the eye and a lacrimal fistula.

Identification of a non-metallic foreign body is often difficult. Thornell,[3] in reporting on a patient with a persistent draining fistula from a foreign body, emphasizes the ineffectiveness of x-ray in demonstrating a nonopaque foreign body.

REPORT OF A CASE

P. A., aged 31, negro, male, entered the University of California Hospital, Ophthalmological Service, on April 3, 1947, for an infectious granuloma of the left orbit. He was referred to the Otorhinolaryngological Service on April 12, 1947, for examination. The patient gave a history of having had "eye trouble" since December 10, 1946, when an irate female companion stabbed him in the left conjunctival sac with a common wooden pencil. He was intoxicated at the time, and his injury caused him considerable edema and pain in the orbit which subsided to its present condition in one week's time. He was told that the pencil had not penetrated more than a quarter of one inch and all of it was removed. He had no complaints other than an inflamed eye.

The patient was a well-nourished and well-developed negro male of about the stated age and not appearing to be ill. Eyes: Both pupils

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and fundi were normal. The left eye showed a granulating mass in the left lower conjunctival sac near the outer canthus. The conjunctiva was inflamed, edematous and covered with a thin white exudate. The vision in the right eye was 20/20 and in the left eye 20/200. No bony tenderness was present about the orbit. Ears: The drums and the canals were normal. Nose: On anterior rhinoscopy, the septum was moderately deviated to the right. A hard, white colored, elongated mass of stone-like appearance and firmly embedded was present between the left lateral nasal wall and the septum at the level of the inferior border of the middle turbinate in its middle third. A moderate amount of mucopus was pouring over the mass. Nothing could be seen on the right except a thick purulent discharge. On posterior rhinoscopy, the same mass could be seen on the left and there was a thick tenacious purulent discharge hanging from both choanae. The posterior wall of the nasopharynx was chronically inflamed. Pharynx: The tonsils were enucleated cleanly. Larynx: The larynx and hypopharynx were normal. Neck: There were a few enlarged lymph glands present along the anterior cervical chain bilaterally. The thyroid gland was not palpable. The remainder of the physical examination was within normal limits. Impression: Rhinolith, left, with secondary infection.

Laboratory findings: Routine urinalysis, blood tests and the fasting blood sugar were within normal limits. The Kahn and Kolmer reactions were negative. A biopsy of the granulating mass in the left orbit was reported as an infectious granuloma. The cultures of the secretions taken from the nose and the left eye were identified as Bacillus Friedlander, type A.

Two sets of x-ray films taken in the oblique view revealed no bony destruction. The sinus films showed clouding of the left frontal sinus and the left maxillary sinus. There was a mucous membrane thickening of the right maxillary sinus.

Prior to entry, the patient had received penicillin and sulfadiazine in therapeutic doses without improvement. While in the hospital, the patient received streptomycin, 1 gram daily, with definite improvement.

On April 12, 1947, under general anesthesia, two portions of a white painted wooden pencil were removed through the anterior nares. One piece, measuring 3.5 cm., was removed with difficulty from the middle third of the left meatus. The other piece, measuring 3.75 cm., was removed from the posterior third of the right nasal cavity near the floor. The latter piece came away easily as it was

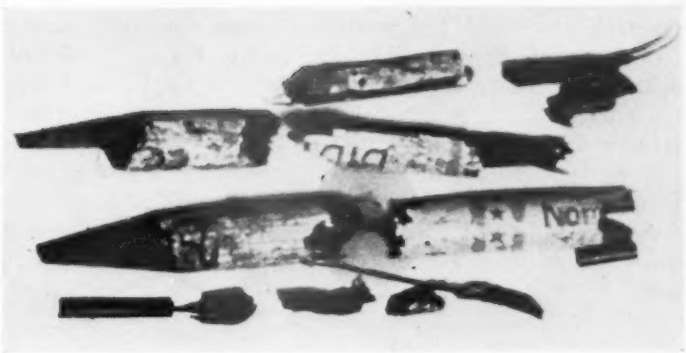

Fig. 1.—Pencil that was removed, actual size.

partially fractured from the first portion at the site where it perforated the nasal septum. On handling both sections came apart where the pencil had been glued on its longitudinal axis. All of the graphite was accounted for except approximately 3.5 cm. from the pointed end of the pencil. A search for it was not successful. Hemorrhage was controlled by gauze packing which was removed in two days. The postoperative course was uneventful with steady improvement.

On re-examination of the previous films the roentgenologist found a shadow of slight increase in density, approximately 6 cm. in length and less than 3 mm. in diameter, extending from the floor of the orbit obliquely downward and posteriorly to the floor of the nasal cavity, posterior to the posterior edge of the alveolar ridge. This is seen only on the lateral view. Films taken on April 18, 1947, show a similar shadow, 3 cm. in length, similar in position to that in the posterior portion of the previous film and seen only on the lateral view.

The patient was discharged from the hospital on April 20, 1947, and was again seen on April 28, 1947, at which time the missing portion of the graphite was found extruded on the floor of the right nasal cavity, posterior third, adherent to dry mucopurulent material. The nasal discharge had almost completely abated and the granuloma had almost disappeared.

X-ray examination on May 15, 1947, showed normal sinuses and no evidence of foreign body.

In retrospect, the pointed pencil must have been driven obliquely backward, downward and medially through the lower outer conjunctival sac of the left orbit. The floor of the orbit deflected the point so as to pierce the lamina papyracea of the ethmoid bone; it then erupted at the posterior inferior portion of the labyrinth to perforate the nasal septum posteriorly and inferiorly to the opening made in the lateral nasal wall. The point came to rest on the floor of the right nasal cavity just anterior to the medial pterygoid plate of the sphenoid bone. The proximal end was completely broken off inside the left ethmoid cells and a partial fracture of the pencil occurred where it came to rest in the nasal septum.

SUMMARY

1. A patient with a wooden pencil in the ethmoid labyrinth and nasal cavity for four months is presented.

2. Aside from a persistent draining sinus of the conjunctival sac, infection and a granuloma, there were few symptoms.

3. The failure to identify the foreign body by x-ray examination again demonstrates the limitation of this laboratory procedure and the difficulty encountered in viewing partial radiopaque bodies.

4. Clinically, the pointed wooden pencil had the appearance and consistency of a rhinolith.

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LXXX

THE FISSULA ANTE FENESTRAM OF THE HUMAN OTIC CAPSULE

I. DEVELOPMENTAL AND NORMAL ADULT STRUCTURE

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The auditory apparatus is remarkable not only for the intrinsic complexity of its nervous elements but also for the exceptional structure of the capsule in which it is housed. Not only is this osseous tissue exceedingly hard, or petrous, but it contains other unusual tissues which appear in established developmental succession. The otic capsule in the adult temporal bone is crossed by four channels of periotic (perilymphatic) nature. Two of them, the aquaeductus vestibuli and the aquaeductus cochleae, are well known and are described in every textbook account of the ear. The other two, the fissula ante fenestram and the fossula post fenestram, are still novelties to the anatomist and otologist.

Only one of the four channels is complicated by the presence, within its space, of a portion of the otic duct-system; this one, the aquaeductus vestibuli, contains the ductus endolymphaticus and its distal enlargement, the saccus. Two of the four, the fossula and the fissula, pass through the wall between the tympanic cavity and the vestibule. The relations of the fossula are simple; it occupies a

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From the Department of Anatomy and the Department of Otolaryngology (Contribution No. 477 from the former) of Northwestern University Medical School, and from the Department of Anatomy of the University of Wisconsin. A study conducted under the auspices of the Central Bureau of Research of the American Otological Society. During the course of the investigation Dr. Cauldwell served on a fellowship endowed by the late George J. Dennis, M.D., and subsequently by Mrs. Dennis.

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position opposite the utriculus in the bony capsule posterior to the vestibular window. Those of the fissula are more complex. Beginning on the vestibular wall, it courses anteriorly toward the cochlea, where it usually turns at a right angle, ascends and ends on the medial wall of the tympanic cavity anterior to the vestibular window.

Currently, interest is centered on the fissula ante fenestram, since it may come to be associated with pathological tissue in the form of a chondroma or of a sclerotic nodule. So frequently, in fact, do otosclerotic foci appear in its territory that the fissular region is regarded as a site of predilection for pathologic changes of such nature. The present problem has two phases: to describe in detail the normal histology of the area, and to search for cellular features which might be interpretative of the transition into a pathologic state.

It is the authors' purpose to bring together here the results of observations on the fissular area and on closely related portions of the capsule, and to draw therefrom some generalizations pertinent to otological science.

The earliest reference to the fissula ante fenestram is that of Huschke,[24] who merely stated that a fissure extended from the vestibule toward the groove of the tensor tympani muscle. Hyrtl[25] pictured a corrosion preparation of the temporal bone of a newborn infant which showed a bulb-like outpouching of the vestibule in front of the vestibular window; however, he failed to describe the structure. In 1873, Hyrtl,[26] in an account of the ear of Hyaena spelaea, described the minute evagination in the outer wall of the vestibule which, in the corrosion specimen, appeared as a stump-like process. He said that while it was absent in most animals, he had found it in a young antelope where a diverticulum from the sacculus projected into it. In 1890, Siebenmann,[49] also employing corrosion preparations, described its slit-like form in man and for the first time employed the term "fissula ante fenestram." In a study of ossification in the human labyrinthine capsule, Ziba[59-60] mentioned, without specifically naming, a persistent zone of cartilage between the stapes and the cochlea containing small spindle-shaped cells. Manasse[32] described a persistent "Knorpelinseln" in the same region anterior to the oval window and suggested that this area, with its related cartilage rests, might be considered the site of predilection for the development of otosclerotic bone. In 1916, the antefenestral area caught the attention of Perozzi in the course of a histologic examination of the otic capsule. This investigator,[44] after working

in Siebenmann's laboratory, stated that to his knowledge the structure had not been previously described or named, whereupon he termed it "Cozzolino's zone" after his uncle and teacher.

Subsequently Perozzi[45, 46] reported on the form and histology of the zone from a comprehensive series of fetal, postnatal and adult human ears. He found it to be constantly present even in the adult. He noted the fissure first in fetuses at the time when the capsule became cartilaginous, and regarded it as a synchondrosis formed in the capsule to permit growth or expansion. Through its presence, he believed, the cavity of the cochlea could more easily enlarge and permit the cochlear canal to describe its spirals. Otto Mayer[34] and Claoue[18] likewise regarded the fissula as a synchondrosis.

According to Perozzi, Cozzolino's zone consisted at first of a peculiar type of loose connective tissue, continuous with similar tissue which in young fetuses filled the periotic space. This tissue extended from the vestibule to the middle ear. In older fetuses the tissue, in growing denser but still surrounded by the cartilage of the capsule, came to resemble a perichondrium. Later, when the capsule ossified, the immediate surrounding tissue remained cartilaginous, even in the adult ear.

In 1922, Kosokabe,[30] in a study of the periotic capsule, redescribed this antefenestral fissure. Although he too carried on his researches in Siebenmann's laboratory, the earlier account of the fissula was again overlooked, and following Perozzi's example, he referred to it as Cozzolino's zone. According to Kosokabe the outer half of the precartilaginous cochlear capsule was the last to change into embryonic hyaline cartilage, whereas the medial half and the canalicular part of the capsule early became cartilaginous. Between these two portions he found, in the early fetus (1½ to 2 months), the raphe-like line, or fissula, between the cochlear and canalicular portions of the capsule. This slit-like zone, composed of closely packed embryonic mesenchymal cells like those of the perichondrium, was observed to retain its configuration and cellular structure until the period of ossification.

Eckert-Möbius,[21] in 1924, also described this area as Cozzolino's zone.

In 1929 and 1930 Bast[7, 8] reported his observations on the fissula ante fenestram, based on serial histologic sections and wax-plate reconstructions. He showed the varied shape and form of the fissula, the constancy of the structure, the periotic character of its tissue at the vestibular end, and the invasion of blood vessels from the

tympanic side. He believed there was no indication that the structure functioned as a synchondrosis which permitted capsular growth.

Since 1930 studies dealing with the structure, form, content and pathology of the fissular region, and the fossular area posterior to the vestibular window, have been reported by Wilson,[53, 54] Bast,[9-12] and Anson[2-6] and their associates. These, in part, form the basis for the following account.

The current report is based upon the study of 300 serially sectioned temporal bones of embryos, fetuses, children and adults, in the collections at the University of Wisconsin, at Northwestern University Medical School, and at the Carnegie Laboratory in Baltimore. These cover developmental stages from that of the 6.7-mm. human embryo to that of the aged adult.

FOSSULA POST FENESTRAM

The first description of the evagination of periotic tissue into the otic capsule posterior to the vestibular window was provided by Ibsen[27] in 1881. He pictured a protrusion of the utriculus into this excavation which he named the "canalis membranaceous caecus"—an epithelial diverticulum which has not since been observed. In 1890 Siebenmann[49] referred to the postfenestral evagination, observed in corrosion preparations, as the "fossula post fenestram." Bast[8] next made reference to this structure in 1930.

The fossula post fenestram (Fig. 1) is an evagination of periotic tissue into the bony capsule just posterior to the vestibular window, at a point about one-third of the way between the window and the nonampullated end of the lateral semicircular canal.[11] It is comparable to the fissula ante fenestram in origin and content. However, it differs from the fissula in that it is more consistently pouch-like and tends to open only into the vestibule. The fossula is an inconstant structure, being present in 67 per cent of 77 ears studied. In 73.33 per cent of the ears bearing a fossula, it communicates with the vestibule only, whereas communication with the tympanic cavity alone occurs in a single specimen (1.67 per cent). In 15 per cent, the fossula forms a complete channel, extending through the otic capsule without interruption of its fibrous content from the vestibule to the tympanic cavity. In 5 per cent of cases alteration of tissue leads to partial or complete obliteration of the fossula by cartilage formation and subsequently by calcification and ossification. This process is similar to that observed in the fissula but the incidence of occurrence is much lower. It does indicate that a histologically un-

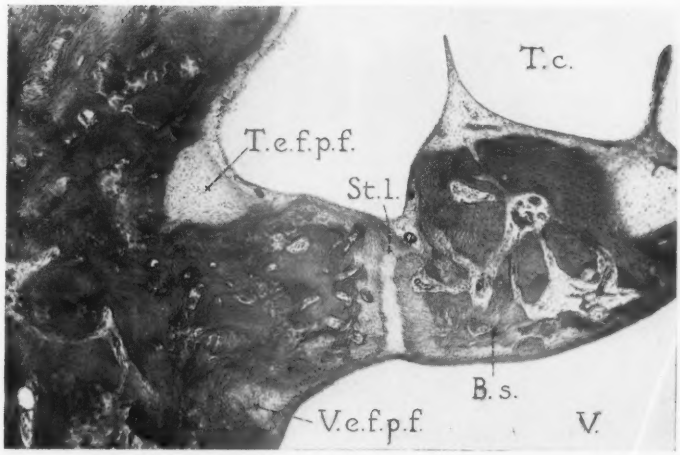

Fig. 1.—Photomicrograph of a section through the fossular region of the otic capsule in a 7-week infant (Northw. ser. 9.7.31). Both tympanic and vestibular orifices of the fossula post fenestram are seen at the same horizontal level. X 41.

Abbreviations in these and succeeding figures: *Ann. lig.*, annular ligament; *Ant. crus.*, anterior crus of stapes; *Bl. v.*, blood vessel; *C. or Coch.*, cochlea; *Conn. tiss.*, connective tissue; *Fen. cart.*, fenestral cartilage; *Fiss.*, fissula ante fenestram; *F.o.f.a.f.*, fenestral orifice of fissula ante fenestram; *Immat. cart.*, immature cartilage (of chondroma); *Int. bone*, intrachondral bone; *Mat. cart.*, mature cartilage; *Muc. membr.*, mucous membrane; *Scl. bone*, sclerotic bone; *T.e.f.p.f.*, tympanic extremity of fossula post fenestram; *T.o.f.a.f.*, tympanic orifice of fissula ante fenestram; *Tymp. cav.*, tympanic cavity; *V.* or *Vest.*, vestibule; *Vest. cart.*, vestibular cartilage; *V.w.*, or *Vest. window*, vestibular window; *V.e.f.p.f.*, vestibular extremity of fossula post fenestram; *V.o.f.a.f.*, vestibular orifice of fissula ante fenestram.

stable area exists in the otic capsule posterior to the stapes and may subsequently undergo pathologic transformation.

FISSULA ANTE FENESTRAM

Development. The fissula ante fenestram develops as an anteriorly directed extension or outpouching of the periotic tissue of the vestibule at the latter's junction with the scala vestibuli. It makes its appearance in the 34-mm. (9-week) fetus soon after the periotic tissue in the region of the vestibule dedifferentiates from precartilage.[16] This early dedifferentiation, as the process operates to

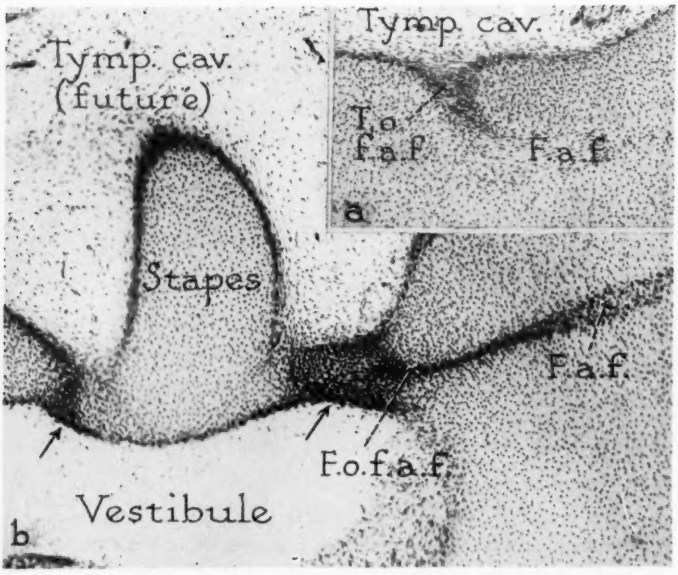

Fig. 2.—Photomicrographs of sections through the fissular region of a 75-mm. (12-week) fetus (Northw. ser. 3.1.41). X 46. *a* is at the level of the tympanic orifice; *b*, at that of the fenestral orifice. At this stage the capsule and ossicles are still cartilaginous. Arrows indicate the site of the stapedial joint.

form the vestibule, occurs in fetuses of 25 mm. (8 weeks) and 30 mm. (8½ weeks), at which stages, however, the fissula is not yet present. In the 43-mm. (9-week) and 50-mm. (10-week) fetuses, when the otic capsule still consists of young true cartilage, the fissular tract is distinguishable as a streak of somewhat altered precartilage. Many of the nuclei in the area of altered capsular tissue are showing degenerative changes, and intracellular vacuoles make their appearance. The tissue in the newly-formed zone resembles, and is continuous with, the young periotic tissue of the enlarging vestibule. Apparently the fissula, then, develops as an anterior extension of the tissue lining the vestibule. These facts indicate that the fissula is not a synchondrosis. The subsequent histologic alteration of the component tissues of the fissula serves to strengthen the authors' conviction that the fissula and an arthrosis are developmentally and functionally dissimilar.

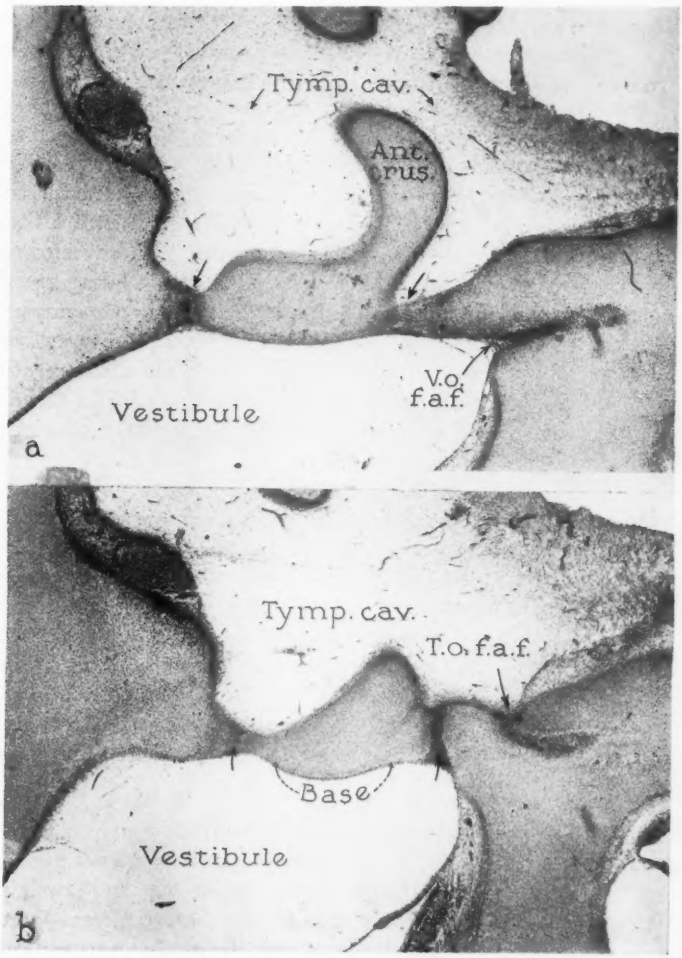

Fig. 3.—Photomicrographs of sections through the fissular region of a 135-mm (17-week) fetus (Wis. ser. 5). X 22. *a* is at the transverse level of the vestibular orifice; *b*, at that of the tympanic extremity. Ossification has not yet been initiated. Unlabelled arrow points to the stapedial joint.

In the 75-mm. (12-week) fetus the fissula reaches the tympanic surface of the cartilaginous capsule (Fig. 2*a*); this communication had not yet been established in the 50-mm. fetus. In the 75-mm. specimen an auxiliary, or fenestral, orifice is present (Fig. 2*b*).

During subsequent weeks there occurs a gradual enlargement of the fissula (135-mm. or 17-week fetus; Figs. 3*a* and 3*b*). The cartilage surrounding the fissular area is poorly stained and the cell nuclei are swollen and necrotic. The cells within the fissula a little farther removed from the vestibule show a tendency to revert to the early precartilage type (Fig. 3*a*). Thus, the fissula is enlarging; its development is more advanced at the vestibular than at the tympanic end. In the former area (Fig. 3*a*) the tissue spaces of the vestibule extend a considerable way into the fissular tract; the entrance of a vascular bud at the tympanic end of the fissula results in the destruction of cartilage in a way similar to that seen in the cartilaginous capsule in the region of the semicircular canals. Because the presence of degenerating nuclei in the fissula indicates nongrowth and because the pale-staining and cellular nature of the surrounding cartilage would suggest growth, it seems likely that the fissula increases in size, at least in part, at the expense of the surrounding cartilage. This enlargement of the fissula has been correlated with the rapid fetal expansion of the entire internal ear and its capsule. Perozzi thought that the enlarging fissula permitted the enlargement of the cochlea and its capsule. But it is more likely that the fissula expands at this period of growth, not to permit the cochlea and capsule to enlarge but as a concomitant growth process associated with the dimensional increase in other portions of the internal ear.

During two and one-half months of fetal life (from the 12th to the 21st week; 75 mm. to 183 mm.), the fissula continues its growth, reaching at the latter stage maximum size and attaining definitive segregation from the surrounding cartilage (Figs. 4*a* and 4*b*). This is the very period during which the cochlea and vestibule attain full size and in which ossification of the capsule is almost complete.

The definite delimitation of the fissula is accomplished at the vestibular end by dipping of the perichondrium of the vestibule into the fissula. This separation is evident in the 135-mm. (17-week) fetus (Fig. 3), but is much more striking in the 126-mm. (16½-week) stage (Anson and Cauldwell, Figs. 29 to 31[6]). Near the tympanic end, the vascular bud which originally eroded the cartilage brings with it connective tissue cells which approximate the area of

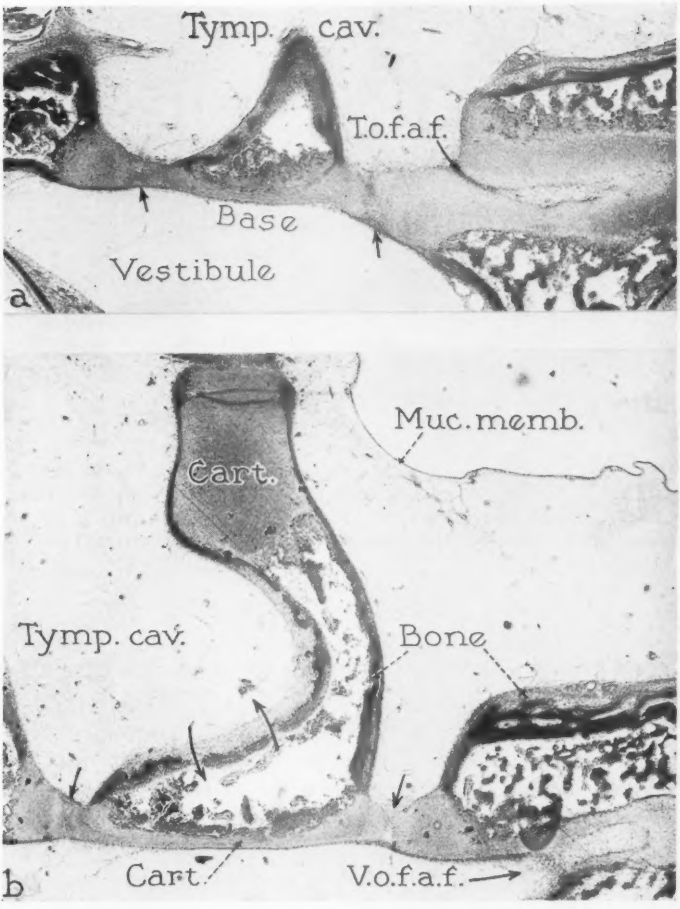

Fig. 4.—Photomicrographs of sections through the fissular region of a 183-mm. (21-week) fetus (Wis. ser. 21). X 24. *a* is at the level of tympanic orifice; *b*, through the vestibular orifice. Ossification is well under way; however, surrounding the connective tissue of the fissula a considerable shell of unaltered cartilage remains. Peripherally the cartilage is being converted into intrachondral bone. Arrows in the wall of the stapes pass through osseous foramina.

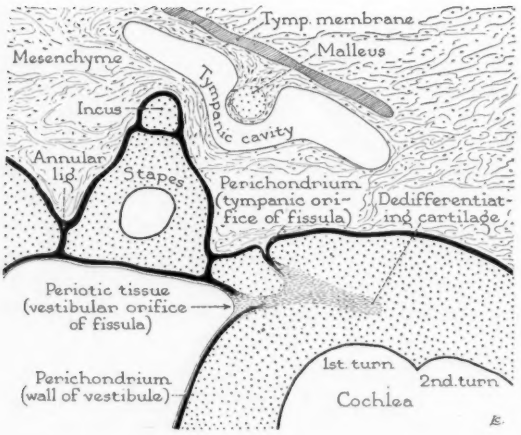

Fig. 5.—Fissular and related areas of the cartilaginous otic capsule in a 100-mm. (14-week) fetus, depicting the way in which the periotic tissue invades the antefenestral portion of the capsule and its relation to the mesenchymal tissue of future submucosal position. (Semidiagrammatic, from Edinger tracing.)

eroded cartilage to form a perichondrium continuous with the external perichondrial layer of the tympanic wall of the capsule (Fig. 4*a*). If the fissula were serving as a center of growth for the expanding cochlear capsule, it might be expected that its space would be almost exhausted at a time when the maximum growth of the cochlea and the capsule had been attained. This, however, is obviously not the case. Actually, at this stage in morphogenesis (fetus of 161 mm. or 19 weeks), the tissue of the fissula is quite different from that seen in the earlier stage. In place of necrotic cells there is actively growing tissue. This transition from degeneration to growth is brought about by the invasion of blood vessels into the fissula from the tympanic mesenchyma. In the 100-mm. (14-week) fetus a blood vessel enters the fissula from the tympanic side, but in the remainder of its structure no vessels are seen. In the 161-mm. fetus not only are numerous vessels present throughout its extent but the connective tissue cells show evidence of marked activity.

During the ensuing two-week period of fetal development the capsule in the fissular region is the site of active ossification. Periosteal bone, in the 183-mm. (21-week) fetus, covers tympanic and

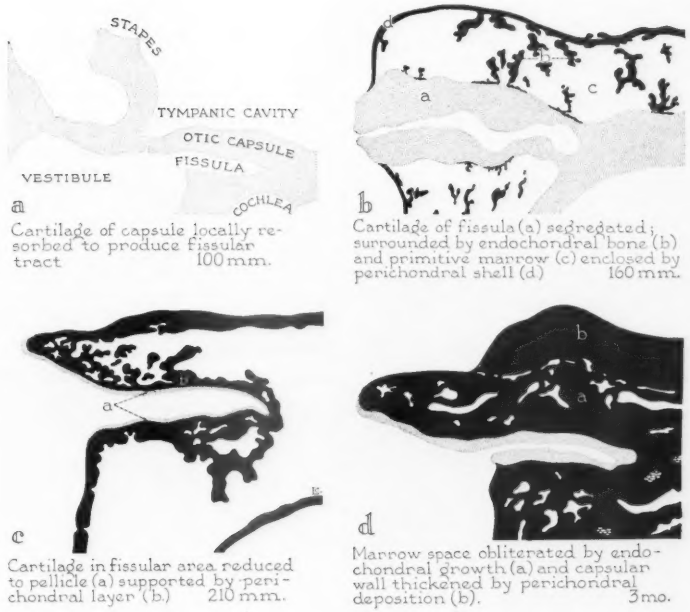
STAPES
TYMPANIC CAVITY
OTIC CAPSULE
FISSULA
VESTIBULE
COCHLEA
a
Cartilage of capsule locally resorbed to produce fissular tract 100 mm.
d
a
c
b
Cartilage of fissula (a) segregated; surrounded by endochondral bone (b) and primitive marrow (c) enclosed by perichondral shell (d) 160 mm.
a
c
Cartilage in fissular area reduced to pellicle (a) supported by perichondral layer (b) 210 mm.
b
a
d
Marrow space obliterated by endochondral growth (a) and capsular wall thickened by perichondral deposition (b). 3 mo.

Fig. 6.—Crucial stages in the development of the fissula, in relation to accompanying changes in the surrounding otic capsule. Stages: 100-mm. (14-week), 160-mm. (19-week), and 210-mm. (23-week) fetuses and 3-month infant. (Semidiagrammatic, from Edinger tracings.)

vestibular walls except in the areas of the fissula and the vestibular window (Fig. 4). In these situations cartilage remains as a fenestral ring which is continuous with a bulky fissular cartilage; the latter, in which the fibrous core is now prominent, extends anteriorly to reach the cochlea (Anson, Karabin and Martin, Figs. 20 and 21[4]). Subsequently the cartilage is reduced in bulk, yet is never totally replaced by bone; circumferentially in the vestibular window, and continuously therewith along the vestibular wall in the vestibular extremity of the fissula, the cartilage persists as a shell. In adult specimens it is converted into bone at the tympanic extremity of the fissular tract.

It would appear from an examination of later fetal and postnatal stages that the fissula virtually retains the form which characterizes it in the 183-mm. specimen.

Briefly, the fissula is a fibrous stripe in the otic capsule, extending from the periotic tissue of the vestibule to the periosteum and submucosa on the tympanic surface of the otic capsule (Fig. 5). Therefore, the periotic tissue of the vestibule, the annular ligament of the stapes, and the periosteum of the bone on the medial wall of the tympanic cavity are continuous. Surrounding that part of the connective tissue which occupies the fissular tract is a thin perichondrium. Apparently it is upon the activity of this pellicle that new cartilage may be formed to reduce the caliber of the fissula in later stages of development. This normal, or common, condition may be altered by secondary activity of the cartilage.

Since the fissula is essentially a specialized zone in a rapidly changing otic capsule, altering fissular structure is best understood when considered as a part of the developmental history of the entire area bounded by the cochlea, vestibular window, tympanic cavity and vestibule. This may be accomplished by examining four crucial stages (Fig. 6).

In the antefenestral area of a 100-mm. (14-week) fetus, primordial cartilage is locally destroyed by invasive periotic tissue along the vestibulo-tympanic streak to form a fissula anterior to the vestibular window, i.e., a fissula ante fenestram (Fig. 6*a*).

At 160 mm. (19 weeks) periosteal bone, spreading toward the area of the window both on the tympanic and vestibular aspects, forms a peripheral shell (Fig. 6*b*). This shell, however, is incomplete since the cartilaginous rim of the window is never wholly replaced. Periosteal bone formation is interrupted, too, at the orifices of the fissula. Thus, throughout the length of the fissular tract, cartilage remains temporarily as an envelope for the fibrous tissue derived from the periotic layer. The cartilage in this area is largely destroyed, but it is to a slight extent converted into calcified cartilage.

At 210 mm. (23 weeks) coalescence of these islets of calcified cartilage, with concurrent resorption of cartilage not so modified, results in the formation of an uninterrupted, but thin, layer of bone bounding the space of the fissula (Fig. 6*c*). The bone is lined on the fissular surface by a periosteal membrane. Almost no spicules have as yet appeared in the marrow area.

At three months, the perichondrium lining the fissula has produced a new cartilage layer which normally remains moderate in thickness (Fig. 6*d*). However, this stratum may retain potentialities for chondrogenous activity, especially when there is excessively

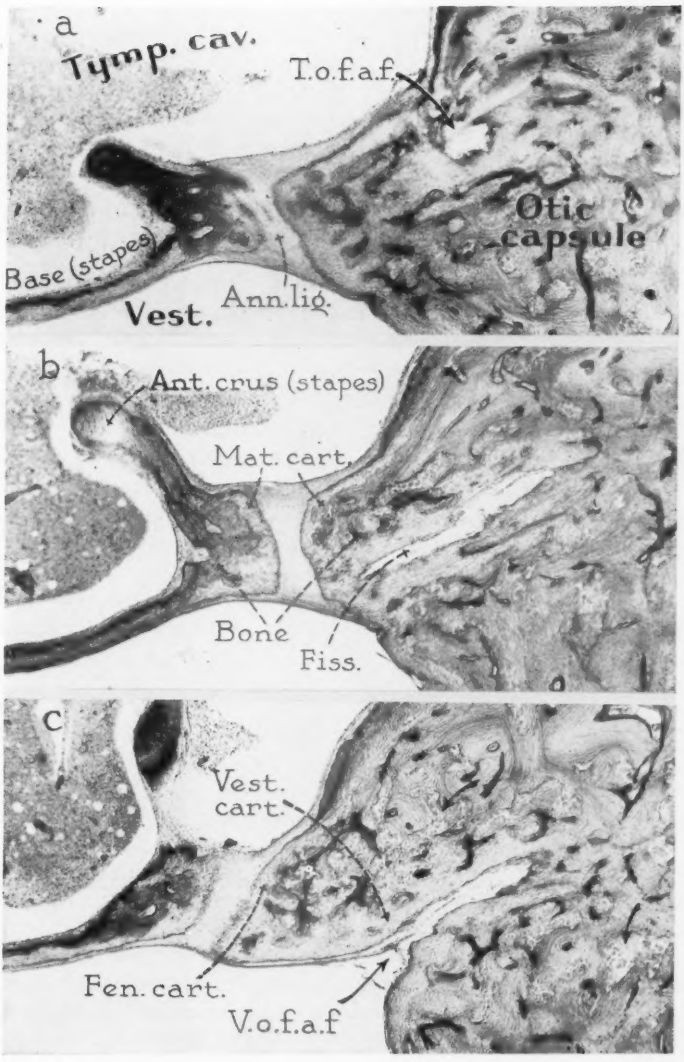

Fig. 7.—Photomicrographs of sections through the fissular region of the otic capsule in a child of 14 years (Northw. ser. 9.23.35; sections 312, 320 and 334). Normal size, form and contents. Short unlabelled arrows point to intrachondral bone ("cartilage rest"). *a* is through tympanic orifice; *b*, fenestral orifice; *c*, vestibular orifice. X 43.

great fissular space to be filled. While cartilage is being formed anew in the fissula as the fetus approaches term, endochondral bone is produced rapidly to render the capsule so strikingly osseous as to make the term "petrous" wholly suitable. Calcified cartilage remains as trapped islets. Concurrently periosteal bone is added to the capsule externally. It is owing to increment of the latter that the petrous part of the temporal bone attains adult size, since the otic capsule does not increase in size after the fifth month of intra-uterine life.

Through all of these stages in capsular development the tissue of the fissula ante fenestram remains as definite as the periotic tissue of the vestibular, canalicular and cochlear spaces. Formed by processes essentially similar to those which produced the portions of the osseous labyrinth, the fissula differs from related periotic spaces in two major respects: it contains no membranous (epithelial) tube; and it is persistently lined by cartilage at the vestibular extremity. As will be discussed in a subsequent article, this cartilage may function as the fundamental tissue in the pathological changes basic to otosclerosis.

Normal Contents and Form. Normal variations in fissular form may be illustrated by employing selected sections from otological series of postnatal stages.

In a child of 14 years the fissula is of typical configuration and regular size (Fig. 7). Near the tympanic, or superior, extremity the fissular stripe of connective tissue is directed inward toward the cochlea (Fig. 7*a*). Midway in its course the fissula is elongate in the anteroposterior plane, with a narrow prolongation toward the vestibular window (Fig. 7*b*). At the vestibular, or inferior, extremity the fissula continues flattened in a mediolateral direction (Fig. 7*c*).

Usually the fissula is elongate and the tympanic orifice is small, and although the vestibular orifice is long in the vertical plane, the height of the entire tract is sufficiently great to place the uppermost margin of the vestibular opening appreciably below the tympanic. As a consequence, both openings rarely appear in the same transverse (horizontal) section. In such instances, however, the fissula crosses the otic capsule as a rather direct passage (Fig. 8a).

Usually the fissula reaches the two surfaces of the otic capsule in the antefenestral region without accessory openings intervening. However, in some instances an auxiliary, or fenestral, orifice oc-

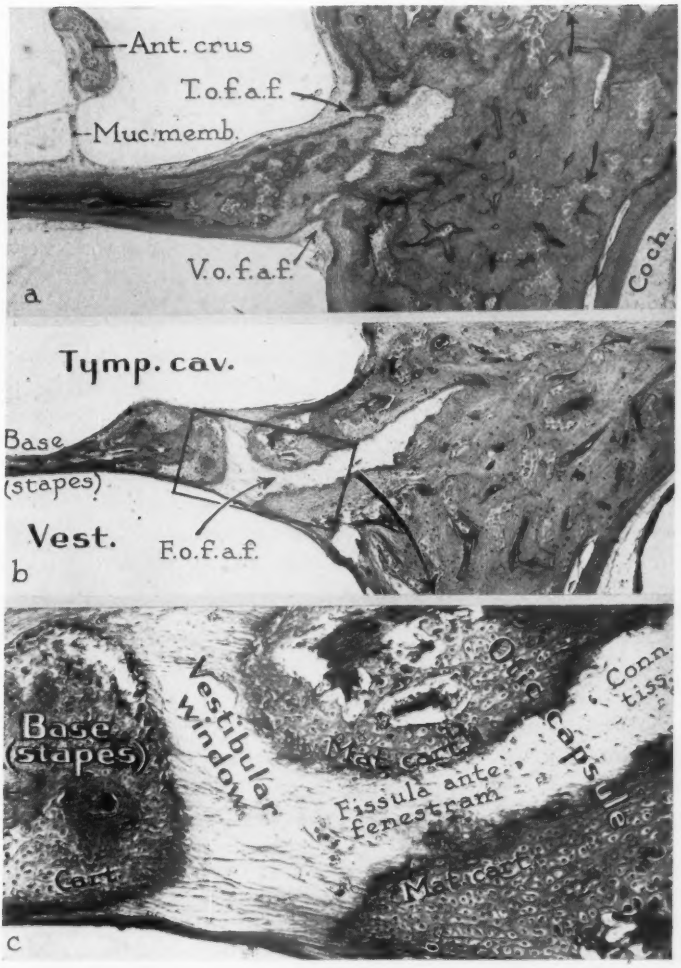

Fig. 8*a*.—Photomicrograph of a section through the fissular area in a child of 8 years (Northw. ser. 7.10.35, sect. 374). Fissula of short, direct, course between the tympanic and the vestibular walls of the otic capsule; normal fibrous content and cartilaginous "shell." Short unlabelled arrows point to intrachondral bone ("cartilage rest"). X 41.

Figs. 8*b* and 8*c*.—Photomicrographs of a section through the fissular region in an adult of 65 years (Northw. ser. 4.10.35, sect. 359): *b*, fenestral orifice of the fissula ante fenestram, X 43; *c*, detail of the fissular and associated fenestral tissues, same section, in the area indicated in *b*. X 179.

curs on the anterior wall of the vestibular window. When present, the fenestral orifice is likely to be small; rarely is it as capacious as in a specimen from a 65-year-old adult (Figs. 8*b* and 8*c*; cf. Fig. 2).

Not infrequently the cartilage shell of the fissula, which without exception is present in normal cases, is completely continuous with similar tissue which always lines the vestibular window without having within its center a band of fibrous tissue. Assumedly, in such instances the cartilage of the primordial otic capsule persists, unreplaced by bone of the several ossification centers. When the fenestral orifice is large, tissue of the annular ligament merges with that of the periotic (fissular) channel (Fig. 8*c*).

The manner in which the cartilage is retained in the region of the fissula ante fenestram to form a peripheral shell is most satisfactorily demonstrated in young individuals. The cartilage lines the vestibular window, adjacent portions of the tympanic and vestibular walls, and the fissula itself (Figs. 9*a* and 9*b*). In the fenestral area, the cartilage of the bilaminar stapedial base faces that of the vestibular window (Fig. 9*a*). This feature is particularly striking in infantile series along the inferior margin of the window (Figs. 9*a*, upper inset, and 9*b*, lower inset).

Just as the perichondrial layer internal to the cartilaginous fissular shell passes imperceptibly into the connective tissue which fills the "space" of the fissula, so, comparably, does the externally placed chondral tissue of the same shell pass by equally gradual histologic change into calcified cartilage islands ("cartilage rests"). This latter tissue is lodged in now rapidly developing endochondral bone (Figs. 9*a* and 9 *b*). The histologic succession, fundamental and commonly persistent, will be discussed later.

Thus established as a fibrous channel in the bone of the otic capsule and lined through all or part of its extent by cartilage, the contained and surrounded tissues bear certain regular relations to one another. These constituents require further consideration.

A. Connective Tissue.—Fibrous tissue is the normal occupant of the fissular channel (Figs. 8*a* to 8*c*; 9*a* and 9*b*). It is formed by a process of dedifferentiation of the cartilage which makes up the primordial capsule.[8] This process is similar to that which occurs in the expanding canalicular area. Whether examined in the late fetus or in the old adult, it is found to be but slightly vascular. Marginally the fibrous tissue passes gradually into cartilage or bone through a perichondrium or a periosteum as an intermediary tissue.

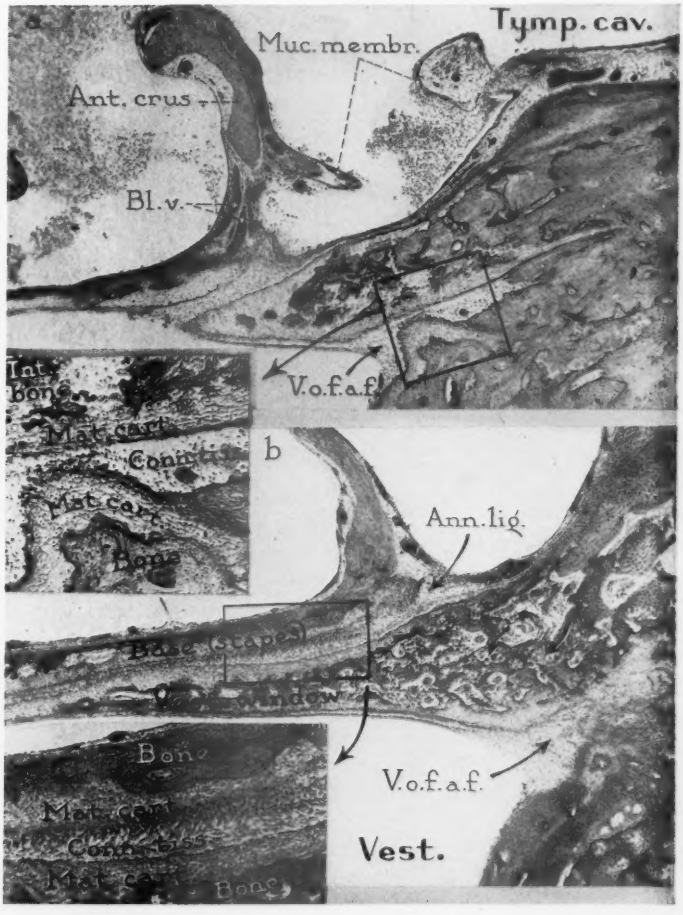

Fig. *9a*.—Photomicrograph of a section through the vestibular orifice of the fissula in an infant of 6 months (Northw. ser. 4.19.34, sect. 280), including surrounding structures. X 41. Upper inset shows the detailed histological structure of the fissular channel and wall in the area outlined in Fig. *9a*. X 94.

Fig. *9b*.—Photomicrographs of a section through the fissular and fenestral regions of the otic capsule in an infant of 7 days (Northw. ser. 5.8.36, sect. 360), showing the regular continuity of the cartilage which lines the fissula with that which borders the vestibular window. Short arrows point to intrachondral bone ("cartilage rest"). X 41. Lower inset, detail of the histological structure in the area outlined in Fig. *9b*, showing the succession of periotic tissue, cartilage, intrachondral bone, and ligament. X 94.

B. Primary Cartilage.—That portion of the capsular tissue in which the connective tissue is lodged is represented by the chondral tube which is present in all fetal and in postnatal stages. Large in the 183-mm. fetus (Fig. 4), it regularly decreases in thickness as age advances. The cartilage is apparently taken over into endochondral bone or calcified cartilage by slowly progressing osteogenesis, since in some old subjects it remains as a readily distinguishable layer only at the vestibular extremity of the fissula, still continuous, however, with the fenestral cartilage (Anson, Karabin and Martin, Figs. 22 and 23[4]). Through the intermediate portion of the fissula and at the latter's superior (tympanic) orifice in such instances the fibrous tissue rests against the osseous tissue of the fissular wall.

C. Cartilage Islands.*—Part of the wall of the fissula in late fetal and in postnatal stages is composed of cartilage islands or

*The attention focused upon these cartilage islands by otologists has tended to obscure the fact that this intermediate type of bone tissue is neither indigenous to the labyrinthine capsule nor peculiar to the human skeleton. The occurrence of islands of calcified cartilage in the petrous portion of the temporal bone has long been known. Boettcher[14] found calcified cartilage rests in the labyrinths of adult dogs and cats, and Gottstein[22] described cartilage islands in the modiolus of the cochlea of a one-year-old child. In 1897, Manasse[31] described "cartilaginous interglobular spaces" in the human labyrinthine capsule. Thereafter intense interest was aroused among otologists with the expectation of a clue to the morphologic interpretation of the pathology of otosclerosis. Subsequently, these cartilage islands were described in apparently normal petrous bones of human fetal, postnatal and adult specimens by Politzer,[47] Ziba,[59, 60] Perozzi,[45, 46] Mayer,[34] Wittmaack,[55] Kosokabe,[30] Meyer,[35-37] Eckert-Möbius,[20, 21] Kolmer,[29] Bast,[7-10, 12] Nager and Meyer,[41] Steinberg,[50] Anson and Wilson,[5] and Causse;[17] in normal capsules of adult anthropoids by Wilhelm;[52] in the postnatal and adult stages of cats and dogs by Haag;[23]; and in chickens by Wittmaack, Werner,[51] Meyer,[38] Altmann,[1] and Oesterle.[42]

Calcified cartilage islands have been described in various bones of the body involved in pathologic changes. Dieterle[19] called attention to persistent inclusions of calcified cartilage in endochondral trabeculae of long bones in cases of hypoplastic fetal chondrodystrophy and in osteogenesis imperfecta. Pommer[48] observed basophilic islands of cartilage in bone tissue in a case of osteogenesis imperfecta. In 1931 and 1932, Nager and Meyer[40-41] reported similar histologic findings in labyrinthine capsules in cases of osteogenesis imperfecta, osteomalacia, and Mongolian idiocy. Recently Zawisch[58] discussed the significance of persistent calcified cartilage or "chondroid bone" in the osteogenesis of marble bone disease (osteopetrosis). Numerous investigators have reported its presence in petrous bones containing otosclerotic foci. Of particular interest are Manasse's[32] comments on the intimate association of cartilaginous interglobular spaces to the "Knorpelinseln," or fissula ante fenestram, in the presence of newly-formed vascular bone in the antefenestral area.

The origin, development, and subsequent fate of the basophilic islands of cartilage in normal long bones of the extremities has been exhaustively studied by Zawisch-Ossenitz[56, 57] in animal and human fetal and postnatal material. Maximow and Bloom[33] merely state that spongy endochondral bone may be distinguish-

"intrachondral bone" (Figs. 7, 8 and 9). Where the primordial cartilage persists as a tube external to the connective tissue and internal to the bone, these cartilage islands remain as a stratum of varying thickness on the external aspect of the cartilaginous tube (Fig. 9). This tissue is formed through the calcification and ossification of remnants of cartilage which were left undestroyed by invasive osteogenetic buds. Thus sequestered during the period of fetal development, the chondral islands endure to some extent in the otic capsules of even aged adults.

In the region between the cochlea and the vestibular window, i.e., the fissular area, this hybrid tissue is especially abundant and it may extend deeply into the surrounding capsule (Figs. 8*a*; 9*a* and

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ed in the epiphyseal region of the developing bone by the remains of calcified cartilage within the lamellae.

Calcified cartilage islands are also seen in the growing phase of "secondary cartilage." They occur as transitory cartilage rests in the chondral ends of the condyloid and coronoid processes of the human mandible.[43] They are prominent during the period of rapid growth and undergo gradual transformation to bone in older individuals, and in their developmental course are histologically identical with the typical islands found in the labyrinth. In rare cases calcified cartilage islands are found in the articular tubercle of the temporal bone.

The transition of calcified cartilage islands into endochondral bone has been generally considered a process of metaplasia (Brandt;[15] Böttcher;[14] Moos and Steinbrugge;[39] Manasse;[31] Ziba;[59, 60] Kosokabe;[30] Eckert-Mobius;[20] Zawisch-Ossenitz;[56] Kaufmann[28]). Kaufmann stated that the metaplastic type of bone formation seldom occurs in the human osseous system but does appear in the lower jaw and "during the endochondral ossification of the petrous portion of the human temporal bone." He also considered that chondrometaplasia occurred in rickets, in the ossification of enchondromas, and in the formation of the fracture callus.

Dissenting opinions concerning the role of chondrometaplasia in the development of the labyrinthine capsule were expressed by Mayer[34], Borst,[13] and Bast.[7] Mayer stated that all cartilage cells were replaced by bone cells in the process of ossification. Borst thought that direct metaplasia was improbable, and mistaken for an insidious replacement of the cartilage by bone. Bast observed the invasion of cartilage cell lacunae by the undifferentiated mesenchymal cells of the osteogenetic buds which assisted in the evacuation of cartilage cell debris and assumed the function of osteoblasts. Thus is explained the multitude of cells frequently seen within the lacunae as compared with the single cell found in a typical cartilage lacuna. Bast introduced the term "intrachondral bone" to replace several interchangeable synonyms (calcified cartilage rests or islands, cartilaginous interglobular spaces). The reader is referred to Bast's papers of 1929 and 1930 for a full account of the origin and validity of the term.

The labyrinthine capsule is distinguished from bones elsewhere not by the mere presence of the calcified cartilage islands (or intrachondral bone), which have been shown to exist in other normally growing and pathologic bones, but by the persistence of these islands of intermediate bone tissue into the adult stage. In comparison with bones elsewhere, the labyrinthine capsule may be considered to consist of relatively immature bone. It remains during life largely in a primitive stage yet capable of achieving greater maturity.[54]

9b).* In passing from the chondral lining of the fissula into the deeper tissues, a gradual histologic transition is encountered, beginning and ending with true bone; the intermediate tissue is represented by the cartilage islands (intrachondral bone). The cartilage islands consist of irregular areas within the endochondral trabeculae whose structure shows variable stages in the transition to bone. The matrix may be amorphous hyaline or calcified to a greater or lesser degree. The cartilage cells lie in typical lacunae which are subsequently invaded by osteoblasts. The periphery of the invaded calcified lacunae are gradually transformed into osteoid and bone.† Areas are therefore seen consisting of calcified cartilage matrix with true bone within its lacunae (intrachondral bone). This intrachondral bone formed in the first week of the ossifying process is a permanent tissue and remains throughout life as a component of the middle layer of the otic capsule.[12] Frequently it is found projecting prominently into the marrow spaces as finger-like prolongations, continuous with collections of the same tissue which are embedded in the endochondral bone of the capsule (Fig. *9b*).

These persistent remnants of calcified cartilage, which have been altered without complete loss of their primordial character, vary in abundance in different persons of the same age and of different ages. Usually, they are more widely distributed in late fetuses and in children than they are in old adults; however, in the capsules of both young and aged, they are likely to be more plentiful in the deeper portion of the middle or so-called endochondral layer where they lie adjacent to the endosteal portion of the labyrinthine wall.

D. Endochondral Bone.—The true mature bone of the fissular region is primary bone similar to that which comprises the bulk of the entire capsule.

Ossification of the otic capsule is progressing rapidly in the 161-mm. stage;[9] in the fissular region it begins on the medial tympanic

*The concentration of calcified cartilage islands (intrachondral bone) about the fissular area has been noted by many investigators (Ziba;[59, 60] Manasse;[32] Mayer;[34] Kosokabe;[30] Eckert-Mobius;[20, 21] Bast;[7-12] Anson and Martin;[3] Anson and Wilson[5]).

†These separate sites of ossification about the old cartilage lacunae represent the so-called "globuli ossei." The concept of "globuli ossei" originated with Brandt.[15] In a study of the process of ossification which included the metaplasia of cartilage into bone, he described the deposition of bone in the form of a ring about the periphery of the cartilage cell lacuna; this structure he called the "capsula ossea." Upon filling of the lacuna with bone, it was identified as a "globulus osseus." Misuse is frequently made of the term "globuli ossei" as a synonym for the entire calcified cartilage island, whereas it was originally applied to the specific globular ossification focus in the cartilage island.

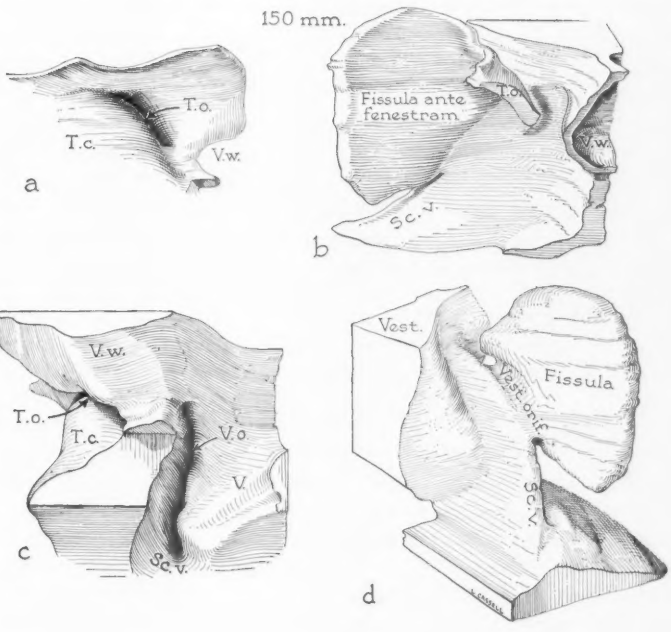

Fig. 10.—Drawings of wax-plate reconstructions of the fissula in a 150-mm. (18½-week) fetus (Wis. ser. 39). X 23. In Figs. 10*a* and 10*c* the fissular region of the capsule has been reconstructed; in Figs. 10*b* and 10*d* the space of the fissula itself and continuous portions of the vestibule, the scala vestibuli, and the wall of the fenestra vestibuli. In *a* and *b* the reconstructions are viewed from the posterolateral aspect(i.e., looking toward the anterior, or cochlear, wall of the vestibular window, and toward the medial wall of the tympanic cavity); in *c* the view is posterior; in *d* it is anteromedial (i.e., as if toward the canalicular part of the otic capsule and the tympanic cavity). In *a* and *c* the reconstruction has been tilted upward, in *b* and *d* downward, at the portion nearest the reader. If the reconstruction shown in *b* were fitted into that depicted in *a*, then the cut end facing the reader in *b* would fill the space marked *T.o.* in *a*; similarly, were the "negative" model in *d* turned about and restored to the space in the "positive" model shown in *c*, the "tissue" along the area marked *Vest. orif.* in the former (*d*) would rest in the "space" labelled *V. o.* in the latter (*c*). The stapes has not been included; a part of the wall of the vestibular window in *c* has been cut away to offer a less obstructed view of the two fissular orifices.

wall and extends into the cartilage toward the fissular tract of connective tissue (Bast, Figs. 9 and 10[9]). In the fetus of 210 mm. periosteal bone has spread to the walls of the vestibule and the cochlea and along the course of the fissula (Bast, Figs. 13 to 15[9]). In the 305-mm. fetus endochondral bone is beginning to obliterate the primitive marrow spaces bounded by the tympanic, vestibular and cochlear plates of the periosteal cone (Bast, Figs. 21 to 24[9]). Part of this endochondral bone is deposited on the "intrachondral" tissue; the latter then remains in the form of islands when endochondral bone has largely displaced marrow.

Modification of the bone next ensues and it soon becomes difficult to distinguish the two types, which during the period of fetal ossification were characteristic in position and configuration.

In respect to density, the capsular bone in postnatal stages exhibits striking variations. In some specimens it is compact, containing few marrow spaces (Figs. 7 and 8*a*), while in others marrow spaces are large and numerous and the intervening trabeculae are small (Fig. 9*b*). Occasionally, the marrow occupies large cavities continuous with the space of the fissula ante fenestram. It is conceivable that within the otic capsule marrow spaces increase with advancing age to produce a condition of rarefaction comparable to that occurring regularly in the stapes.

E. Extracapsular Tissues.—There is a marked increase in the size of the petrous portion of the temporal bone between the fetal and adult stages. Its length in the adult is approximately one and one-half times as great as that in the fetus at term, whereas its width is almost doubled. Thus, while the essential portions of the contained otic capsule remain unaltered after full size is attained in late fetal life, the temporal bone as a whole undergoes marked increase in dimensions.

Variability in the form of the normal fissula can be graphically illustrated through the use of a selected series of reconstructions.

The vestibular extremity of the fissula is regularly elongate and oblique as it extends anteriorly and superiorly from the vestibule, at the site of continuity of the latter with the scala vestibuli (Figs. 10*b* and 10*c*). The vestibular orifice is usually about 0.15 mm. in width and 0.3 to 1.0 mm. in length. The tympanic extremity is small and it is either oval or slit-like (Fig. 10*a*). Between these extremities the body of the fissula is in the shape of a keel (Figs. 10*b* and 10 *d*). The main portion of the fissula commonly assumes this alar config-

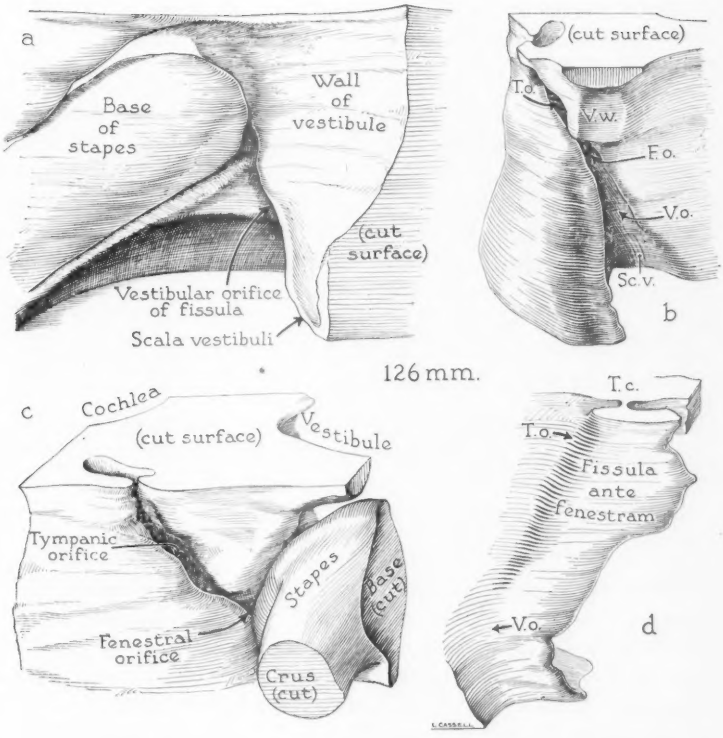

Fig. 11.—Drawings of wax-plate reconstructions of the fissula in a 126-mm. (16½-week) fetus (Wis. ser. 11). X 20. In *a*, *b* and *c* the capsule has been reconstructed; in *d* the space of the fissular (fibrous) tract (*d*, the "cast" of the space, could be fitted into the fissular "excavation" shown in *a*); *a* and *d* are of the medial aspect, *b* the posterior, and *c* the lateral. In *a* and *c* the anterior portion of the stapes is included. The fissula is open, without interruption, as a continuous cleft across the three portions of the capsular wall, namely, tympanic, fenestral, vestibular.

uration to a marked degree even in the young fetus, and while the vestibular extremity follows a plane corresponding to that of the body (Fig. 10*d*), the plane of the tympanic extremity is likely to be offset therefrom at a right angle (Fig. 10*b*).

The tympanic and vestibular orifices, and the fenestral orifice when it occurs, are usually distinct and in some specimens complete continuity exists between these openings. This condition is well established in the 126-mm. fetus (Fig. 11). The fissula in such cases is a deep excavation in the capsular cartilage, which extends from the junction of the vestibule and the scala vestibuli obliquely in a superolateral direction, to cross the fenestral rim and terminate on the tympanic surface of the otic capsule (Figs. 11*b* and 11*d*). The tympanic orifice appears as an elongate sulcus immediately inferior to the semicanal for the tensor tympani muscle (Fig. 11*c*).

Usually the fenestral orifice is wanting. The fissula ante fenestram then communicates only with the tympanic and vestibular portions of the labyrinth. The main body of the fissula is somewhat offset anteriorly to within a short distance of the cochlea and superiorly to a point slightly beyond the level of the tympanic orifice.

Departures from typical form are frequently encountered. In some specimens the body of the fissular tract extends cranialward to a level opposite the tensor tympani muscle; in others its height is not unusual but its capaciousness is striking. Apparently a large space occupied as it is merely by connective tissue invites histologic activity of chondrogenous or osteogenetic nature, with the result that the original fissular area may become replaced by cartilage or by a mass of vascular bone. These histopathologic changes will be described and figured in a succeeding paper.

CONCLUSIONS

The histologic structure of the antefenestral region of the otic capsule, between the vestibular window and the cochlea, is exceptional in that it consistently includes a cleft-like fissula occupied by unmodified connective tissue. This fissula ante fenestram extends vertically from the scala vestibuli to the tympanic cavity near the hamulus for the tensor tympani tendon.

The fissula appears in the 34-mm. stage through invasion of the primordial cartilaginous capsule by the periotic connective tissue of the vestibule; with maturation, the periotic invagination becomes the connective tissue content of the fissular tract.

During the process of ossification of the otic capsule, cartilage persists as the lining of the fissula. At its periphery endochondral bone forms, as early as the midterm stage, an investing osseous shell.

Peripheral islands of calcified cartilage (intrachondral bone) occur abundantly about the fissula and throughout the fissular region.

Typically, the fissula is an open S-shape in anterior coronal outline, narrow and cleft-like, and occupied by connective tissue. The superior or tympanic part is commonly twisted at a 90-degree angle in relation to the inferior or vestibular portion.

Variation in size and form is common. Occasionally the body of the fissula is capacious; it then has the appearance of a pouch rather than a cleft.

The widened fissula may be occupied, in whole or in part, by a cartilaginous mass, which can encroach upon the stapedial ligament in the presence of an auxiliary, or fenestral, orifice.

The fissular area is one of great histologic instability, a circumstance which renders it vulnerable to pathologic change, the vestibular window subject to invasion, and the stapes liable to fixation within its fenestra.

SUMMARY

Serial sections of 300 temporal bones of fetal, postnatal and adult stages have been studied.

The developmental anatomy of the fissula has been traced from its inception in the 34-mm. fetus to the young infant.

Assumption of adult form and subsequent lesser changes in morphology have been determined.

The nature of the contained and of the surrounding histologic elements of the fissula has been described.

Groundwork has been laid for a consideration, in a subsequent article, of aberrancy in form of the fissula and for a discussion of pathologic tissues which may occupy the fissular area.

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LXXXI

OTOGENOUS CHOLESTEATOMA

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The physical characteristics of an otogenous cholesteatoma conform to a very definite pattern. This round mass of putty-like consistency lies in a clear-cut cavity within the mastoid process. It is covered with a fibrovascular membrane, which, in certain locations, may so closely resemble the surface of the sigmoid sinus that it cannot be differentiated until the true sigmoid sinus is exposed or the mass more completely dissected out.

Within this mass are layers of keratinized skin-like sheets mixed with cholesterin crystals. The center is usually broken down by a secondary infection and gives off a foul, musty odor.

One has but to review the literature to determine the lack of definite pathological conclusions which have been made about this lesion. I believe that most of this confusion is due to the failure to differentiate the so-called true cholesteatomata, which are defined by many pathologists as pearly tumors of concentric structure which grow from the brain and the meninges and are probably degenerated endotheliomata.[1] This lesion has no connection whatever with the cholesteatoma of the ear or the surrounding bone, as it is in no way related to any previous infection. The confusion apparently exists because the otogenic lesion, upon physical examination, has some of the same physical characteristics as the so-called true cholesteatoma. From here on, there is no connection whatever between the two lesions.

Clinically, it is definitely proven and generally accepted that all otogenic cholesteatomata are secondary to chronic middle ear and mastoid infections. No dependence should be placed upon the statement that true cholesteatomata arise in the brain, because the otogenous cholesteatoma only reaches the brain by the extension of infectious complications, which have their origin within the adjacent mastoid cells.

Several of the older writers have tried to work out the true etiology of cholesteatoma by associating it with certain perforations of the ear drum and associated middle ear disease.

From my experience, this has no pathological bearing upon the lesion. I have always believed in the late Dr. Ballenger's advice regarding the proper location for incision of the ear drum. He stated it very simply by saying, "Always incise where the drum bulges." If we do not incise where the drum bulges, it still would rupture in this area with the obvious formation of a fistula. This no more reveals the true origin of the underlying disease than the opening of a fistulous tract in the leg following osteomyelitis.

The otologist must accept the complete responsibility for the unnecessary development of this lesion, regardless of the exact pathological nature by which this lesion develops. Clinically, it always begins with infection in the middle ear and mastoid process, which in some cases may pass unrecognized because of a small amount of primary secretion or sufficient drainage by way of the eustachian tube.

It is the continuous attacks of this infection, with repeated exacerbations, which eventually develop into the so-called chronic suppurative ear, with a subsequent development of the cholesteatoma. All chronically infected ears do not develop a cholesteatoma, but all cholesteatomata which do develop arise from this source.

The failure to care properly for the infected middle ear and mastoid cells is the direct cause for the development of a cholesteatoma. Local treatment may temporarily give comfort to the patient and the anxious parents and relatives, but it also gives comfort to the underlying nest of bacterial flora which continue their activities without interruption.

Clinically, a patient with a cholesteatoma does not develop any significant symptoms. As in all chronic infections, the patient gradually becomes accustomed to the odor, the occasional drainage, and the pain, which is usually not confined to the ear but involves the side of the head with no particular point of tenderness. There is no postauricular swelling or tenderness, as the underlying eburnized bone protects the periosteum from the irritation of the infectious turmoil beneath.

Due to its ivory-like hardness, the labyrinth is so well protected that it is seldom directly involved. Adjacent inflammatory reactions may bring about some dizziness and tinnitus. The patient

rarely has fever with these attacks. Sudden increased drainage from the ear promptly relieves most of the symptoms, and he proceeds from one attack to another with the belief, hope and expectation that his ear will eventually get well.

So long as a cholesteatomatous lesion remains limited to the mastoid cells, there are no serious complications. Unfortunately, the lesion progresses by slow but direct extension, and following the lines of least resistance eventually comes to the most vital structures within the head, namely, the meninges and the sigmoid sinus, which, with its companion, carries three fourths of the returning blood from the brain. This invasion passes through the meninges so slowly and nature is able to wall off the infection so tightly that a diffuse fulminating meningitis rarely develops. Gradually, one of the most quiet and deadly infections takes place. Without the knowledge of the patient or his attending physician, a completely encapsulated brain abscess develops, the formation of which has been going on for months or years, and suddenly so overwhelms the victim that the true underlying pathological processes pass unrecognized.

The patient is so completely desensitized that he cannot be aroused enough from his stupor for sufficient information to be obtained from him to determine the true cause of his disaster. The association of the cholesteatomatous complication is not recognized because only one half of all brain abscesses are diagnosed before death.

Obviously, the patients who do not have necropsy studies and whose illnesses have passed unrecognized or misdiagnosed naturally account for a large number of these victims. Nevertheless, enough studies have been made upon patients who have been operated upon for a brain abscess and in whom the lesion has been found at necropsy to impress upon one the direct association of cholesteatoma and brain abscess. About 80 per cent of all brain abscesses are otogenic, and of this number 65 per cent follow chronic ear discharge.

In less than 10 per cent, the cholesteatomatous lesion is suddenly activated by a new bacterial flora, which is brought to it by the patient having contracted some virulent upper respiratory infection, such as scarlet fever, measles, or influenza, and with insufficient drainage a sudden activation of this old quiescent lesion may extend so rapidly to and through the dura that an overwhelming fulminating meningitis occurs.

The other hazardous complication is the sudden extension, caused principally by the location of this burrowing lesion, through the wall of the exposed sigmoid sinus. This frequently occurs in the same pathological manner as that described for the meningitis.

Recently, I have seen three such complications. A 17-year-old school boy worked on a farm during the summer vacation. While hot and perspiring, he was caught in a cold rainstorm. That night, his "chronic ear," which had drained intermittently since early childhood, began to give him extreme pain. The following day he had a severe chill, and after being treated for three days for malaria was brought to my surgical service, where at operation I found an old cholesteatoma with an extension into the sigmoid sinus, from which an infected clot was removed.

The infection within the cholesteatoma which has lain dormant and with very little evidence of clinical disturbance, upon breaking forth, contains the most virulent and destructive organisms in the body. Once they have directly invaded the blood stream, the patient is extremely septic and in spite of blood transfusions and penicillin therapy usually has a hard battle for his life.

In retrospect, one can always say that this complication, too, could have been avoided.

Hearing loss, due to the chronically infected ear with cholesteatoma, is much more serious than the patient is willing to admit. The easy acceptance of this tragedy by the patient is brought about because the opposite ear is usually unimpaired. However, hearing loss develops in the opposite ear, because, where cholesteatomata are present, there has been primary bilateral otitis media in 21 per cent of the cases.

The patient then seeks immediate relief for his so-called sudden deafness. Unfortunately, in most cases, any restoration of hearing in the cholesteatomatous ear is hopeless. Occasionally, the removal of the infectious debris, where the middle ear has not been extensively involved, gives an appreciable increase in hearing. The outcome is so uncertain, however, that any promise of this restoration is unfounded. Again, we have a preventable serious complication.

The treatment of cholesteatoma lies primarily in its prevention. A properly performed and well-timed mastoidectomy should prevent the development of every one of these lesions.

Gradually, all physicians and many laymen are beginning to appreciate the fact that a mastoidectomy is no longer a dangerous operation and that it has the same specific indications as an appendectomy. When properly performed at the proper time, it offers the same permanent relief from future trouble. Unfortunately, the great mass of the people, especially anxious mothers, still have an undeserved horror of any surgical procedure.

As practically all types of acute ear infections, regardless of the violence of the onset, gradually subside and because of an apparent freedom from symptoms and the patient's seemingly good recovery, it is quite natural that the parent who was originally alarmed by the acute symptoms is almost equally startled when advised, during the course of what appears to be a satisfactory convalescence, that the child needs a mastoidectomy. Unless the parent has implicit faith in the advice of his otologist, he is loathe to accept this unexpected course and resorts to more simple therapeutic procedures.

Since all acutely infected ears, as in any other inflammatory reaction, have a tendency to get better without any form of treatment, naturally the anxious parent is inclined to accept any type of treatment as a successful means of cure.

Recently, there has been added to this false security several of the so-called "wonder drugs," such as the "sulfa drugs," penicillin, and streptomycin. They all have their place ~~and I have seen in my own patients~~ miraculously favorable results which could not have been attributed to any other cause. However, there still remains a definite number of illnesses, whose characteristic clinical symptoms and true diagnosis are so camouflaged by the administration of these drugs, that the patient may no longer have drainage, ear pain, fever, or leucocytosis and yet eventually develop serious intracranial complications, which with their sudden and unexpected exacerbation demand life-saving surgical measures. At operation, the true underlying concealed infection, which has been continuously progressing without recognizable symptoms, is exposed.

Rapidly, the limitations of chemotherapy in bone disease are becoming known. I find many patients whose lives have been jeopdized by the false belief that they are recovering from the disease, and although complications have not arisen which demanded surgical relief, yet, this type of patient still has an underlying infectious bone disease, having the same background for the development of a cholesteatoma, which will eventually exhibit all of its destructive characteristics.

The radical mastoidectomy has been accepted as a proper surgical treatment for this lesion. Usually, the destructive processes of the cholesteatoma are confined principally to the middle ear and, therefore, the larger portion of the radical operation has already been performed. At times, the middle ear may not be the primary seat of infection and the surgical procedure should not be designed for an exclusive attack upon this area.

Often, one sees the facial ridge destroyed, and if the cholesteatomatous debris has been removed, an apparently complete dissection has been made. Unfortunately, this is not the case, because isolated pockets of the cholesteatoma have already invaded various compartments of the mastoid process and it is physically impossible to remove them all completely. While the operative procedure may retard another exacerbation of infection for several years, yet, eventually, there is always a recurrence of the lesion.

I have watched patients develop exacerbations of this lesion without any intervening symptoms five to seven years after I have operated upon them. At one time, I was prepared to report a series of these patients as cured, when suddenly they began to return to me with all of the clinical evidence of acute postauricular soft tissue reactions, which, upon exploration, revealed the progressive and hidden activity of the old lesion. Upon this basis, I have been forced to admit that I have no complete surgical cure for cholesteatoma. Of course, the earlier they are attacked and the more completely the mastoid cells are exenterated, including the zygomatic and petrous sections, the more delayed is the recurrence and the less likely the patient is to develop serious intracranial complications.

I thought at this time that the injection of a strip of viable temporal muscle and the tight periosteal flap closure[2] would subdue any activity of the old lesion. Based upon disappointing results with these, I have come to the conclusion that one must accept a cholesteatoma of the temporal bone as a chronic incurable bone lesion.

To all outward appearances it may lie dormant for years but there is continuous and progressive involvement of the bone cells, which may eventually involve the dura, the sigmoid sinus, the labyrinth, the facial canal or the intracranial contents by direct extension produced by the invading erosion.

This lesion is so well encapsulated by the surrounding hard bone that it is impossible for any type of therapy to reach the lesion by

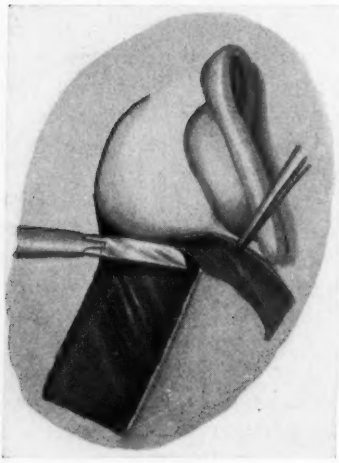

Fig. 1.—The primary postauricular incision is made and the neck flap dissected.

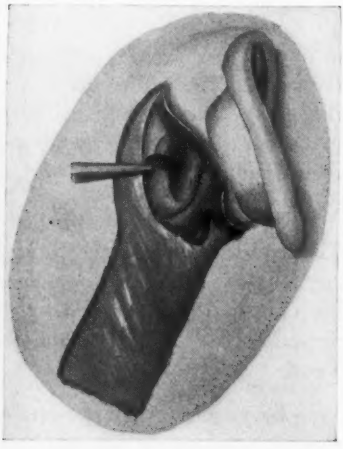

Fig. 2.—The skin flap is sutured, with the knots tied on the inner side. The edge of the tubular graft is folded back upon itself and sutured, so that all raw edges within the tube are eliminated. A No. 8 rubber male catheter is inserted within the tubular graft.

Fig. 3.—The tubular graft is inserted into the antrum.

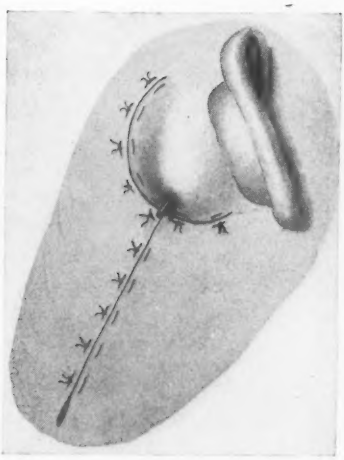

Fig. 4.—The postauricular wound is sutured after snugly inserting the tube into the antrum and the neck wound is sutured after cutting away the triangular excess of skin at the tip.

way of the lymphatics or the blood stream and, therefore, we must accept the futility of such therapeutic adjuncts as the sulfonamides or penicillin, except for the treatment of the complications involving the surrounding tissues.

With these facts in mind, I have applied to this lesion a surgical procedure[3] which I have used over a period of 11 years. The procedure consists of the construction of a permanent and continuous postauricular skin-lined drainage tube from the cavity where the cholesteatoma originally arises.

On account of the surgical technique of this procedure, the lesion should be recognized prior to operation in order that the proper surgical plans can be carried out. This involves a primary incision, which includes the construction of a full thickness skin-lined tubular graft, formed by extending the usual mastoid incision down below the tip onto the neck, and is carried out by the following surgical steps:

1. The primary incision is made and the neck flap dissected.
2. The postauricular incision is carried through to the bone.
3. The skin flap is sutured with the knots tied on the inner side.

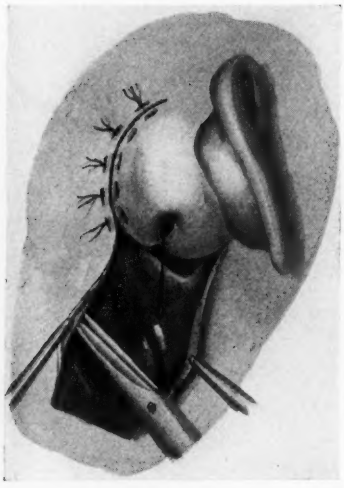

Fig. 5.—The neck wound is undermined about its entire border, approximately one inch.

4. The borders of the tube are approximated smoothly and snugly and the tube is held rigid during this procedure by the use of a tension suture.

5. The edge of the tubular graft is folded back upon itself and sutured so that all raw edges within the skin-lined tube are eliminated.

6. A No. 8 rubber male catheter is inserted into the skin-lined tube.

7. The tubular graft is inserted into the mastoid antrum.

8. The neck wound is undermined about its entire border approximately one inch.

9. The postauricular wound is sutured after insertion of the tube into the antrum, and the neck wound is sewed down to the square tip.

10. The triangular excess of skin at the tip end of the neck wound is cut away and discarded.

11. The edges of the triangular raw surface beneath the external orifice of the inserted tube are approximated by the use of a continuous pursestring suture.

12. A pliable parrasine mesh is placed directly over the postauricular area, with lateral reinforcements of an extra layer running transversely over the neck wound, and flexible collodion applied.

13. Soft marine sponges are placed over the sound as a compression dressing.

This operation carries no additional surgical risk. There is no delay in wound healing. It is not painful and gives no deformity. There is a small opening well hidden behind the external ear, and drainage is so intermittent and slow that after the normal tissue reaction has subsided, the patient is often unaware of this new drainage route.

In addition to establishing this permanent skin-lined tube, which never closes, there is the better ventilation afforded to the infected cholesteatomatous cavity and the progress of the lesion is sharply retarded. Also, this postauricular tube in no way impairs the drainage which has previously occurred through the middle ear by way of the external auditory canal. On the contrary, the semivacuum, which may occur deep within the mastoid cells, may be obliterated due to this through-and-through double drainage and ventilation.

In addition to drainage through the external auditory canal, it also permits drainage through the eustachian tube, so that we have a possibility of three drainage routes from this deep-seated lesion. Since cholesteatomata are always profusely infected, it is impossible to add any bacterial hazards by the construction of this new channel. It is not so much the extensive establishment of drainage to the lesion which inhibits its progress, as the fact that any activity within the lesion immediately finds relief of pressure which is intermittently built up by the accumulation of cholesteatomatous material and associated infected debris.

Since it is a well-established fact that a cholesteatoma progresses more rapidly when completely isolated and surrounded by dense areas of bone, it is reasonable to assume that any method by which this condition can be avoided would retard the intracranial extension of the lesion.

The prognosis in the nonsurgical patient is purely speculative, except, often during the occasional suppurative attacks, therapeutic

agents, such as liquids, are applied locally in the external ear canal with the belief and hope that they will reduce the exacerbations of a quiescent infection. Local treatment of the perforation of the drum is pathologically ridiculous, because it is futile to attempt to close the only avenue of drainage from the underlying focus. The perforation is pathological proof of the underlying infection.

If the patient, after his illness has been diagnosed and he has been advised of his true condition, still refuses to have any surgical procedure, he should not be discarded, but forewarned of symptoms which may arise which would be indicative of the previously mentioned complications of this lesion.

Very often he may suggest to some strange physician that he has been forewarned of these symptoms, and that the chills and fever are probably not due to malaria but to an infected sigmoid sinus; that his headache is not migraine or heat stroke but a dural irritation, produced by the extension of the cholesteatoma; that if his headache persists, and he vomits, has a slow pulse and subnormal fluctuations of temperature, he may, before he falls into that lethargic state, so arouse an interest in the quiescent infection of his ear (which has probably never been examined) that his symptoms may be attributed to a brain abscess.

Even at this late stage surgery is still indicated, and although it has quickly developed into a major procedure, it may still be a means of rescuing him from this complicating disaster.

SUMMARY AND CONCLUSIONS

1. The physical characteristics of a cholesteatoma conform to a definite pattern.

2. There is a lack of definite pathological conclusions regarding this lesion.

3. All otogenic cholesteatomata are secondary to chronic middle ear and mastoid infections.

4. The otologist must accept complete responsibility for the unnecessary development of this lesion.

5. All chronically infected ears do not develop a cholesteatoma, but all cholesteatomata which do develop, arise from this source.

6. Local treatment gives only temporary relief.

7. Clinically, a patient with a cholesteatoma does not develop any significant symptoms.

8. The lesion progresses by slow but direct extension, following the lines of least resistance, and sigmoid sinus thrombophlebitis, meningitis or a brain abscess often will result.

9. Cholesteatoma carries a mixed bacterial flora with exacerbations arising from new infections.

10. In most cases, any promise of restoration of hearing in the infected ear is unfounded.

11. The treatment of cholesteatoma lies primarily in its prevention.

12. Limitations with chemotherapy in bone disease are rapidly becoming known.

13. There is no surgical complete cure for cholesteatoma. While a mastoidectomy may retard an exacerbation of infection for several years, eventually there is always a recurrence of this lesion.

14. The earlier a cholesteatoma is attacked and the more completely the mastoid cells are exenterated, including the zygomatic and petrous sections, the more delayed is the recurrence and the less likely the patient is to develop serious intracranial complications.

15. Ventilation and drainage of a cholesteatoma is maintained and progress of the lesion is retarded by the establishing of a through-and-through full thickness skin-lined postauricular tubular graft.

16. Since it is a well-established fact that a cholesteatoma progresses more rapidly when completely isolated and surrounded by dense areas of bone, it is reasonable to assume that any method by which this condition can be avoided would retard the intracranial extension of the lesion.

17. All patients with a cholesteatoma, who refuse to have any surgical procedure, should be forewarned of symptoms which may arise which would be indicative of intracranial complications.

1617 PROFESSIONAL BUILDING.

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LXXXII

MASTOID BONE BIOPSIES

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The object of this paper is to try to evaluate biopsies of the periantral or tip regions of the mastoid bone in doubtful cases of bone involvement.

As a result of the improvement of instruments for securing biopsy specimens of bone marrow in blood diseases, a puncture and subsequent biopsy of the mastoid region has become more feasible. The technical procedure is no longer experimental; indeed, the use of a small trephine, designed by Turkel for puncture of the sternum, has become very valuable. This is particularly true in cases in which clinical observations, as well as x-ray findings, were doubtful or inadequate.

Although x-ray studies of a mastoid in the early stage of otitis give us valuable information regarding the type of pneumatization and the position of the sinus plate and tegmen, nevertheless the pathological changes cannot be explored and hence remain obscure. This is especially true in children where pneumatization becomes arrested early by previous infection, and in the diploetic bone structure where x-ray findings frequently show thickening of cell walls suggesting disease of the mastoid. Often, however, no pathological changes can be verified in the bone after operation.

In constitutional conditions, such as senile hyperostosis of the mastoid, roentgenologic interpretation may prove unsatisfactory in the presence of an intercurrent acute middle ear infection. When clinical symptoms are not sufficiently prevalent to influence the therapeutic procedure, little reliance can be placed upon the x-ray findings alone.

Clinical symptoms in mastoid infections may also be obscured when the external auditory bony canal is obstructed—whether by generalized hyperostosis or by large single or multiple exostoses. A similar difficulty in diagnosis arises in cellulitis of the cartilaginous

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portion and in furuncles which frequently produce a complete occlusion of the lumen of the external canal. Benign and malignant tumors in the region of the external canal may also mask a simultaneous inflammatory condition of the middle ear and mastoid regions.

Special attention should be paid to so-called latent otitis in children. In this type of otitis the symptoms from the ear, such as pain and discharge, are indistinct and the x-ray findings insufficient; however, the pathological changes in the mastoid are usually very advanced. One must resort to surgical intervention in order to establish the differential diagnosis of a mastoid infection in a latent otitis.

From a practical point of view it is of utmost importance that pathological changes in the mastoid bone, in case of obscured symptomatology, should be visualized either by puncture or by biopsy.

During the past two years puncture of the mastoid area was performed 36 times in a variety of cases. No complications were encountered. In a number of instances the procedure gave valuable information on bone and mucosal pathology and influenced the therapeutic measures.

Several illustrative cases are reported to demonstrate the application and usage of puncture.

REPORT OF CASES

CASE 1.—An 11-month-old girl was referred by a pediatrician in December 1945 with a typical history of gastro-intestinal disorder and inability to gain weight. Occasional vomiting occurred after feeding.

Otological examination showed both external canals to be narrow and dry; the drums were dull, with no light reflex and without perforation. The nasal and pharyngeal mucosas were negative. The left mastoid was punctured in the antral area and a few drops of yellow mucoid fluid aspirated.

Following puncture, a trephine biopsy needle was introduced and a bony cylinder 2 mm. in length removed.

Microscopic study showed a small bony sequestrum with empty lacunae embedded in inflammatory tissue. Deep bone absorptions were observed from cells of the vascular granulation tissue. The endosteal membrane was entirely absent.

A large myringotomy performed on the right drum membrane and antrotomy of the left mastoid led to rapid recovery.

CASE 2.—A boy, two and a half years of age, was brought to the Illinois Eye and Ear Infirmary with a history of recurrent left otitis and a temperature of 101°-102° of three days' duration.

On examination the right ear appeared normal. The left mastoid area exhibited a slight edema. The external canal was dry; the drum membrane was thickened without a light reflex; no perforation or secretion could be seen.

X-ray plates showed diploetic bone pneumatization, but no pathologic changes. Puncture of the middle ear proved negative.

A specimen removed with the trephine needle showed a bony bar separating two cell lumina. The superficial lamella exhibited partly empty lacunae and dense blue lines close under the mucosa. The mucosa was thickened, edematous and infiltrated with lymphocytes. Bone absorption was detected under the mucosa, interrupting some blue lines from recent bone deposits.

A simple mastoidectomy was performed and revealed pale granulations and thickened mucous membrane. The cell lumina were filled with mucopus.

CASE 3.—A patient, 42 years of age, was sent to the Illinois Eye and Ear Infirmary from the Manteno State Hospital with a history of a subacute otitis media following a spontaneous perforation of the left drum membrane.

About two months prior to admission the patient had been treated with sulfathiazole; he also received over 1,500,000 units of penicillin. The secretion stopped but headache and the pain in the left ear persisted. Edema developed over the left mastoid two days prior to admission. Temperature on admission was 102° F.

The patient appeared very confused and examination of the ear was performed with great difficulty.

Under general anesthesia the left mastoid was punctured and 1 cc. of greenish-yellow pus evacuated. A biopsy specimen was taken from the tip area of the mastoid.

Microscopic sections revealed a zone of lamellate bone with a corresponding area of the bone marrow. In the latter and in the perivascular tissue one could observe much inflammatory activity

with bone destruction and regeneration. Large multinucleated osteoblasts placed in rows destroyed the underlying bony lamella, causing deep indentations. Alternating with the bone absorption, areas of new bone production were seen through the activity of small mononuclear osteoblasts. New bone appeared as an undifferentiated pale eosinophilic membranous deposit (osteoid). The adjacent marrow spaces and the cell lumina were filled with exudate, large mononuclear cells, plasma cells and polymorphonuclear leukocytes.

A simple mastoid operation was done and practically the whole mastoid was found filled with granulations. Frank pus was present in the dura of both fossae and at the sinus wall after the bone in these sections had been destroyed.

The patient made an uneventful recovery as far as the ear was concerned; his mental condition improved considerably.

CASE 4.—A boy, six years of age, was admitted to the Illinois Eye and Ear Infirmary with a history of a discharging right ear following an attack of sore throat four weeks before. Temperature on admission was 101° F.

The external canal was narrowed by an inflammation of the skin. Some pus and debris filled the slit and the drum membrane could not be examined.

X-ray plates showed fairly good pneumatization but no destruction of bone.

Puncture of the mastoid was negative.

Histologic study of the specimen removed through puncture presented two bars of cancellous bone attached to each other by connective tissue. The osteocytic cavities appeared empty and the perforating bony canals were filled with exudate. The neighboring space appeared filled with a granulomatous mass consisting of capillary loops, plasma cells and occasional fibroblasts. The microscopic picture was that of a typical granuloma as seen in a subacute form of mastoid inflammation with loss of endosteum.

A simple mastoidectomy was performed and the cell structure was found filled with hemorrhagic granulation tissue. Uneventful recovery followed.

CASE 5.—H. M., 60 years of age, was admitted to the Illinois Eye and Ear Infirmary in February 1946, with a history of a chronic suppurative right ear draining for ten years. About a year before the patient had had severe pain and swelling behind the ear; a facial

paralysis developed. This condition gradually subsided but recurred about one month before, with painful swelling in the retro-auricular area.

The general condition of the patient at the time of admission was relatively good. The temperature was normal. The external canal was filled with granulations which bled easily when touched with a probe. Purulent hemorrhagic secretion from the canal was rather profuse. The retro-auricular swelling was painful on palpation. There was complete facial paralysis in all three branches, with no response to faradic or galvanic stimulation.

The right ear was completely deaf. Irrigation with cold water produced a first-degree nystagmus with typical past-pointing to the irrigated side, and a slight degree of subjective dizziness.

A probe was passed through the posterior bony canal wall, but this produced a hemorrhage requiring packing.

Roentgenologic examination revealed an extensive destructive process, about 5 x 7 cm. in diameter, in the right mastoid region, extending to the anterior canal wall and the articular fossa of the mandible.

Puncture of the mastoid area produced a red-gray mass which was placed in fixation fluid and prepared for section.

The specimen obtained by puncture revealed a serofibrinous mass infiltrated with red blood cells. In the center of the section one could see islands of connective, laminated keratin structures. In the periphery of the section were keratin lamellae carrying cords of anaplastic cells with nuclei varying in size and chromatism. Multinucleated cells and abnormal mitosis in spindle-shaped cells were observed. The histopathologic diagnosis was epidermoid carcinoma.

The patient had another hemorrhage following examination of the external canal. He refused to stay in the clinic for irradiation therapy and was discharged to his referring physician.

CASE 6.—A boy, 5 years of age, complained of attacks of pain in the left ear. The mother noticed that his hearing was impaired, changing in character several times a day. This condition had existed for two months.

Examination revealed gray drum membranes, retracted and without signs of inflammation. The external canals were normal.

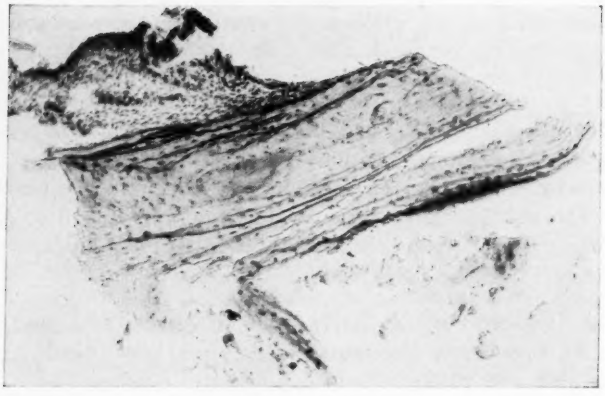

Fig. 1.—Photomicrograph of section of bone removed for biopsy, showing a thickened hyperplastic mucosa in a mastoid with arrested pneumatization.

The left mastoid region was tender to pressure. The retromandibular glands were palpable but not painful.

The nasal mucosa was congested but no pus was found. The tonsils were hypertrophied and a large adenoid mass was seen in the nasopharynx. Transillumination showed normal aeration of the sinuses.

Audiometer tests revealed a hearing loss of 25 decibels in the middle range, but this was not constant.

Whispered voice was heard about four feet from the left ear and the spoken voice six to eight feet.

The larynx and teeth were normal.

Roentgen films of both mastoids showed moderately advanced pneumatization. The cells were small and indicated a decreased translucency bilaterally. In the upper section of the left mastoid, in the region of the sinus dura angle, a large, rounded and well defined density was evident.

The patient was kept under observation for six weeks; he still complained occasionally.

Following a negative puncture of the middle ear a 2 mm. long bony cylinder was removed for biopsy (Fig. 1).

The histological examination of the biopsy specimen revealed a bar 2-mm. in length of longitudinally lamellated structure. The peripheral lamella was separated from the compact bone by a large blue cementing line. The covering mucosa appeared proportionately thicker than normal endosteum.

The epithelial lining was composed of columnar cells with large nuclei in a stratified arrangement. There was no distinct basement membrane visible. The subepithelial layer, abnormally high, consisted of large fibroblasts, connective tissue fibers and small capillaries without cellular infiltration. The mucosa corresponded to the hyperplastic type as seen in partly arrested pneumatic mastoids.

After tonsillectomy and a scrupulous removal of adenoid tissue from the tubal regions, the patient showed a marked improvement.

The ear symptoms disappeared and the hearing returned to normal four weeks after surgery.

Technique. After cleansing the skin with tincture of metaphen and alcohol, 2 cc. of 1% novacaine or 1% intracaine solution are injected into the skin and the periosteum near the tip of the mastoid in adults, or into the antral region in children in whom the cortex is still thin. In about five minutes the local anesthesia is effective enough to proceed with the puncture. In children it is sometimes useful to use a short general nitrous oxide anesthetic or a few drops of ethylchloride.

Different types of needles can be used. I prefer Turkel's instrument which consists of two needles with stylets, an outer guiding needle (14 gauge) and an inner trephine needle (17 gauge). The guiding needle with a filling stylet is introduced through the skin, subcutaneous tissue and periosteum until it meets bony resistance. It pierces the tissue without excising and directs the inner trephine needle to the desired position after the stylet is removed. A few taps with a small mastoid mallet are sufficient to penetrate the bone. The stylet is then removed and replaced by the trephine needle. The trephine needle has four saw teeth and the inside surface of the tip converges so that the excised bony tissue becomes arrested in the needle.

While fixing the head of the outer needle with the fingers of the left hand, the head of the cutting trephine needle is rotated with the fingers of the right hand backwards and forwards in a half circle. A sudden release of resistance inducts the entrance of the cutting needle into a mastoid cell or the antrum. Both needles are then

removed and the bony plug from the inner needle is pushed out by the inner stylet. The specimen is about 2 cm. long and requires a 24-hour decalcification. In urgent cases it can be embedded in paraffin, sectioned into 7-10 micron thick slides and stained with hematoxylineosin.

There were no complications whatsoever after puncture and subsequent trephining of the bone. In one case the introduced needle encountered a blood vessel but the practically sterile puncture had no dire consequences.

The punctured skin healed perfectly in all cases. In five cases of positive x-ray findings and indefinite clinical findings the puncture was repeated after a lapse of time. The primary histological negative findings were confirmed and the patients recovered uneventfully without surgical interference.

SUMMARY AND CONCLUSION

Puncture of the antrum and of the tip is recommended to secure a biopsy specimen of the mastoid bone. This procedure is particularly useful when clinical symptoms are uncertain and other laboratory methods not reliable enough to make a precise diagnosis. Biopsy specimens are easily removed from the mastoid bone under local anesthesia. The excised material is sufficient for histopathological studies and the interpretation of findings is satisfactory in most cases. However, mistakes through failure to obtain a specimen from the right place are possible. The puncture is recommended as a laboratory aid rather than an operative procedure.

The manipulation is without danger to the bone itself, the sinus, or the facial nerve in its mastoid course.

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LXXXIII

REPORT OF TWO CASES OF STENOSIS OF THE LARYNX AND TRACHEA

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and

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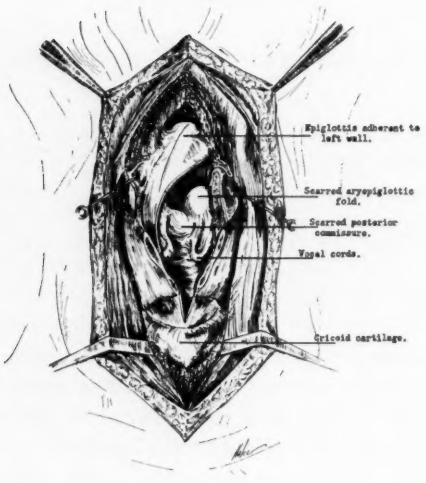
We present two cases of battle wounds involving the larynx and trachea, one of which resulted in a marked stenosis of the cords and supraglottic area. The second case resulted in stenosis of the cords and almost complete obstruction of the trachea.

Case 1.—This male, aged 22, was wounded in action on July 7, 1944, in Italy. He was evacuated to a Field Hospital and a tracheotomy was done. It was found that he suffered severe lacerations of the neck and compound comminuted fractures of the mandible and the hyoid bone. He was evacuated to the Zone of the Interior, where a bone graft of the right mandible was done.

When he reached the Plastic Service at Percy Jones General Hospital, his bone graft was stable. Examination was negative except for scars on the anterior surface of the neck and the tracheotomy wound. The larynx could not be visualized and there was a complete obstruction of the airway. On April 12, 1946, a direct laryngoscopy was done and no glottic opening could be visualized. Following this a second laryngoscopy was done and a small opening was seen which we thought represented the glottis. This was dilated several times with no improvement. Roentgenograms taken at this time were not informative.

On November 27, 1946, the interior of the larynx was exposed through a midline incision. There was an anterior synechia of the cords. This was freed and attention was given to the supraglottic region where there apparently was a veil completely obstructing it. This was opened and found to be a densely scarred membrane. The mucosa was preserved and all scar tissue removed. This mucosa completely covered the raw area so it was felt that no skin graft was necessary. An acrylic stent was placed in the area and held by wires,



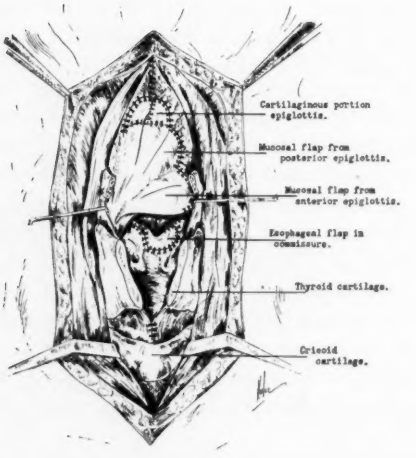


Fig. 1 and 2, Case 1.—Drawings showing condition at second operation and utilization of the mucosa of the damaged epiglottis to reconstruct the anterior wall.

according to the method described by Figi. The epiglottis was not visualized and since it had not been seen from above, we felt that it had been destroyed. The stent was retained in place about three weeks and was then removed by means of a string brought out through the patient's mouth at the time of operation. Following operation it was found that the patient had a definite flutter valve effect. He could exhale with ease but inhalation was completely obstructed.

On December 19, 1946, a direct laryngoscopy was done and much to our surprise the epiglottis was visualized lying over the glottis and attached by its tip to the left posterior pharyngeal wall. The patient was given extended leave to allow the tissues to return to normal.

On May 16, 1947, the old scar was reopened and the hyoid bone cut across for better exposure (Figs. 1 and 2). There was a dense scar, webbing across the posterior commissure. The right arytenoid was absent and on the left aryepiglottic fold there was a redundant mass of tissue resembling a polyp. There was a marked annular constriction in the supraglottic region. The tip of the epiglottis was freed. It was considerably distorted near the base. The mass of tissue on the left aryepiglottic fold and the scar band in the posterior commissure were removed. A flap of esophageal mucosa was elevated from the anterior wall of the esophagus and used to cover this area. There was considerable tissue loss anteriorly and any attempt at closure produced a constriction. An incision was made along the attachment of the border of the epiglottis to the right side of the pharynx and all the mucosa dissected off this structure. The resulting double petal-shaped flap was used to close the anterior wall. The cartilaginous portion of the epiglottis was saved to add support to this region and was sutured securely to the muscles of the floor of the mouth. The same acrylic stent was used at this operation.

Three weeks following the operation the stent was removed. For two or three days postoperatively the patient had some difficulty in swallowing. He quickly learned how to handle fluids and food.

It was not necessary to dilate the larynx. Examination showed a wide airway, good functioning of the cord and the left arytenoid. Except for slight huskiness the voice was normal. Two months after the operation the tracheal opening was closed and the patient discharged from the hospital with no evidence of obstruction.

CASE 2.—This 20-year-old male soldier was wounded in action by enemy shell fragments in Germany on March 14, 1945. He suf-

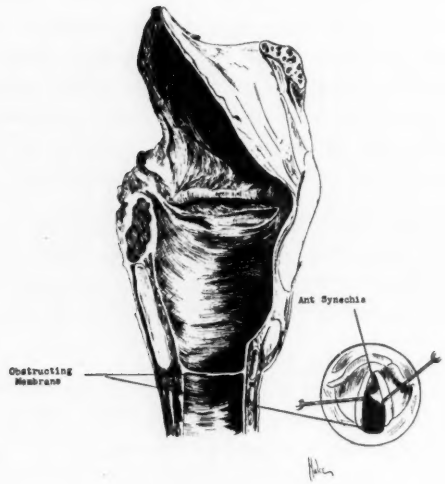


Fig. 3, Case 2.—Cross section of larynx showing obstructed membrane.

fered penetrating wounds of the neck and chest. An emergency tracheotomy was perfomed by the Collecting Station and he was transported to the rear. He developed an empyema which was drained and after recovery was evacuated to the Zone of the Interior.

Physical examination showed only the scars on the anterior side of the neck and the scar from rib resection. The larynx was visualized with ease. The cords were mobile but were webbed anteriorly. About one inch below the cords a diaphragm was encountered which obstructed four fifths of the trachea. There was a small opening about 3 mm. in diameter at the right anterior wall (Fig. 3).

On January 4, 1946, the trachea was opened from the tracheotomy tube to the level of the cricoid cartilage. A thin membrane was found just below the cricoid. This membrane was excised and a stent placed in the trachea. A skin graft was not necessary since the raw area was only about 1 mm. in width. No attempt was made to expose the cords since we felt that this deformity could be handled more safely from above. After three weeks the stent was removed. The patient was given leave and on return in April 1946 a laryngoscopy with cutting of the anterior synechia was done. Following this, he was dilated repeatedly over a period of eight months, accord-

ing to the method described by Jackson. At the end of this time the airway was good and there was no tendency towards stenosis, so the tracheotomy wound was closed and the patient discharged. His voice was practically normal and no obstruction was present.

Comment. In both cases because of the long period of breathing through the lessened resistance of the tracheotomy opening, it was necessary to reassure the patient often until he became accustomed to breathing through the normal channels.

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LXXXIV

THE IMPORTANCE OF CORRECTING OUTSTANDING EARS

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As with any other marked bodily characteristic, the importance to the individual of deformingly prominent ears depends upon his personality. The same three classifications apply in relation to ears that Joseph[1] distinguished in persons with nasal deformities.

One group shows no emotional response but only regards the situation as interfering in some way with his activities. Another, fortunately small, number overreact and make the abnormality a factor of exaggerated importance. Between these extremes is the largest group, those who dislike the unesthetic effect and realize that it interferes in their personal relationships, both economic and social.

To the plastic surgeon, each of these classes is of equal importance, and all are subjects for surgical correction.

The causal factor in prominent ears is not well understood. The abnormalities of the ear in size, shape and position on the head are varied and numerous, so varied that no two cases are exactly alike. However, it is of interest that the character of this type of deformity is usually the same in both ears.

The external ear (auricle) is normally situated on the side of the head, with its upper cranial attachment on a direct line with the outer canthus of the eye. Its generally oval contour is often described as shell-shaped. Its attachments surround the external auditory meatus.

The exposed surface of the normal auricle presents a number of folds and prominences which follow a generally constant pattern. The outer rim is folded forward throughout its greater extent to form the helix. Following the general direction of this outer fold and within its concavity is a second fold which forms a more or less flattened ridge, the antihelix. The anterior portion of this fold lies within the sharply curved forward portion of the helix. The depressed space, or sulcus, between the helix and the antihelix is

known, because of its outline, as the scapha (boat-like). Within the curve of the antihelix is a roughly bowl-shaped cavity, the concha (shell). The concha leads directly into the external auditory meatus. The lower extremity of the antihelix is continuous with a small tissue process, the tragus. Just beneath the lower curve at the anterior end of the helix and on the anterior rim of the external meatus is a cartilaginous eminence, the antitragus. This small process is separated from the tragus, which it closely resembles, by a narrow cleft. The lower extremity of the auricle may appear as a more or less pendulous lobule of varying size, or the posterior fold of the helix may curve slightly downward and directly forward to an attachment just below the external meatus, with little or no lobular tissue.

The external ear is made up of a thin framework of yellow fibrocartilage, closely surrounded by a fibrous perichondrium and covered externally by thin cutaneous tissue. These outer layers are all closely interwoven to form an elastic investment of the thin, mobile cartilage.

The lobule of the ear is composed of fibrous tissue and more or less fat.

Sebaceous glands are present on both surfaces of the auricle. They are particularly well developed in the fossae. Sweat glands are very few and are widely spaced.

Three ligaments attach the external ear to the cranium: the anterior ligament, from the helix and tragus to the zygoma; the superior ligament, from the superior border of the external meatus to the spine of the helix; the posterior ligament, from the mastoid process to the concha.

Six muscles can be distinguished but only three are well developed: The helix major, from the spine of the helix to its anterosuperior margin; the helix minor, which overlies the crus of the helix; the antitragus, from the antitragus to the lower extremity of the helix.

The blood supply is from the external carotid through its temporal and postauricular branches.

The lymphatics lead into the anterior and inferior auricular lymph nodes, and rarely into the postauricular nodes.

The nerve supply to the muscles (motor) is by the postauricular and temporal branches of the facial nerve. The sensory nerves are

branches of the vagus, great auricular and small occipital nerves, and the auriculotemporal branch of the mandibular division of the trigeminus.[2-4]

Regarding the embryology, the external ear is developed from six "tubercles" which appear during the sixth embryonic week around the margin of the first branchial groove, and also from the elevations of the primitive epithelium behind the tubercles on the hyoid arch. By the latter part of the second and the first part of the third month, the contour resembles that of the mature organ. This begins at the upper posterior part, where separation from the cranial surface begins and extends forward so that the antihelix and the triangular fossa at its upper concavity are entirely covered over. In man this process is transitory and after two weeks there is a return to the normal position. At the sixth fetal month, the margin of the ear curls forward and the helix and the antihelix begin to form. This point in development is of particular importance in a consideration of prominent ears, since the formation of the helix and the antihelix determine the normal angle of the auricle to the cranium.[2, 3, 5, 6]

The question of the function of the external ear in man appears to be largely a matter of opinion. Considered by Marx[5] as a vestigial organ, it is regarded by Suraci[7] as a definite aid to hearing and in localization of sound. Fulton[8] says the whole organ, but especially the concha, may be considered as fulfilling more or less perfectly the function of collecting the sound waves and reflecting them into the meatus. These viewpoints should be considered of importance in corrective operations on the auricle.

The external ear may be abnormal in size and shape without being prominent. It may also be prominent and at the same time present any one or more variations in contour. The question of prominence is the one which is to be considered here.

Protrusion of the auricle is generally conceded to result from a lack of development of the normal fold of the antihelix. In the normal ear the sharp angle of the antihelix separates the scapha from the concha. This angle directs the helix backward toward the cranial surface. When the antihelix is not present, its normal convexity is replaced by a concavity, the helix is brought forward and the normal 30-degree encephalo-auricular angle becomes an obtuse one. This condition is expressed by New and Erich[9] as, the cephalo-auricular angle is decreased in proportion to the increase in the convexity of the helix.

From an analysis of the postauricular angle in prominent ears, Young[16] has concluded that the angle between the concha and the mastoid process remains essentially normal and that the setting outward of the auricle corresponds to an increase of the angle between the scapha and the concha, which results from absence of the fold forming the antihelix. This lack directs the ear away from the head.

Before correcting outstanding ears by surgical means, the condition of the patient should be determined by a careful physical examination and laboratory examinations, including urinalysis, blood Wassermann and blood chemistry tests. If positive findings are present, operation should be delayed until suitable medical treatment has been given.

As the first step in preparing for the operation, photographs are taken, showing front and back views of the ears. This record will be a help both to the surgeon and to the patient, since it shows what the corrective procedure has achieved when compared with the postoperative photographs.

With the patient sitting before a mirror, a demonstration is made of the planned correction by holding the ears in the desired position. The patient is told that a promise of perfect result cannot be made but that improvement can be expected.

The amount of tissue to be removed at operation is mapped out in the office. Instead of following the usual custom of indicating the lines for incision, the writer holds the ear against the head at the desired position and makes a single cross on the back of the ear, midway on the proposed line. The ear is pressed against the head where the cross has been made with dye and this records another cross to mark the posterior incision.

A piece of firm cloth is then placed behind the ear and cut to correspond to the distance between the two crosses. The cephalo-auricular and caudo-auricular angles are marked on the cloth, and in this way an exact pattern is obtained for the desired amount of skin to be removed. A duplicate of this cloth pattern is made in silver or lead foil, which will not stretch or shrink and which lends itself to easy sterilization. Both ears are treated in this way and "right" and "left" are marked on the pieces of foil, since the two pieces may be quite different.

The patient is then taken into the darkroom and the foil pattern is placed in position behind the corresponding ear. With a

strong light behind the patient, who is viewed from the front, the metal gives an exact outline which is marked by injecting methylene blue or alcoholic mercurochrome. The dye thus injected stains the exact amount of cartilage to be removed.

Three grains of sodium amytal are given one hour before the operation is started.

It is the custom of some operators to shave the hair for a distance of an inch behind the ears, but the writer prefers to have a clear, normal hairline to indicate the exact postauricular landmarks.

The face and the fields of operation are thoroughly washed with hot water and tincture of green soap; then rubbed with alcohol, followed by iodine, and again with alcohol. The external meatus is closed with cotton and the head is draped with sterile towels, leaving the field about the ears free.

A general anesthetic is always used by some surgeons; others prefer to limit general anesthesia to children and to employ a local anesthetic for adults. This latter method is the choice of the writer.

A local anesthetic serves two purposes: it blocks the nerve and the infiltration of the fluid aids in the separation of perichondrium and cartilage.

With a 1% or a 2% solution of novocaine hydrochloride with five drops to the ounce of 1:1000 epinephrine hydrochloride, a quadrangular field about the ear is infiltrated. The needle is inserted subcutaneously at four points on the cranial surface. The exact points for inserting the needle must depend upon the extent of the skin undermining to be done. For the usual operation they are: about a half inch from the middle of the front of the ear; the same distance away on a horizontal line behind the outer free ear margin, and the same distance above the ear, and below the border of the lobule. The needle is always directed along the imaginary line between the four points and the fluid is expressed along the track of the needle as it is withdrawn.

The auricle is similarly anesthetized to include the area of operation. This may be done on either the anterior or the posterior surface.

Surgical correction of protruding ears is not an operation of recent origin. In 1845, Dieffenbach[10] removed skin from the back of the auricle and sutured the ear cartilage to the cranial periosteum. This type of operation was done repeatedly but with only temporary

success, as the resilience of the auricular cartilage overcame the tension of the overlying skin. Ely (1882) has been credited with being the first to remove a strip of auricular cartilage for correcting prominent ears Other names which appear in the progressive development of this operation are Joseph (1896) Gerard (1903), Gersuny (1903), Morestin (1903), and many others.

A method devised by Ruttin[11] consisted of making two parallel, slightly curved incisions, one on the back of the ear, another on the cranial surface at a sufficient distance from the first to correct the position of the ear. A strip of fascia lata was attached to the perichondrium along the posterior border of the helix and carried subcutaneously to the mastoid process, where it was passed under an elevated strip of periosteum and drawn backward until the ear was at the desired angle. Then the strip of fascia was stitched to the periosteum.

Gersuny[12] did a rather unique corrective operation by turning back a skin flap based on the mastoid process. Two narrow vertical strips of cartilage were removed from the back of the auricle, and other strips cut at right angles to the first were excised from this area. This left small islands of cartilage with spaces between. The periosteum of the cranial surface was then sutured in turn to each of the islands of auricular cartilage and the skin was resutured.

The basic idea of more recent operations is said to have been instituted by Luckett,[13] who was the first to recognize the importance of the antihelix in the normal contour of the ear.

Eitner[14] made a transverse incision over the back of the ear and the mastoid process, excising a suitable sized piece of cartilage, and closed the wound as an up-and-down incision, thus bringing the ear back toward the cranial surface.

The technique of Davis and Kitlowski[15] has been used with various adaptations.[9] The ear is held back in a normal position against the head and the upper and lower limits of contact are marked with dye. The line of the proposed reconstruction is indicated by punctures of the auricle 1 cm. apart, each one marked with dye. The ear cartilage is then incised along this line through the entire length of the antihelix. This point is particularly emphasized as necessary for destroying the spring action of the cartilage. Both margins of the cartilage are turned forward by passing a catgut suture through the perichondrium on one side about 0.5 cm. from the cut border, carrying the needle across the intervening space, then through the peri-

chondrium at a similar distance from the cartilage border. Five sutures are placed and then all are drawn up at once and tied in order. By turning the cut edges of the auricular cartilage forward in this way, a fold is created which forms an antihelix that is nearly normal and corrects the protrusion of the auricle.

Young[16] has described a method in which the line of the normal antihelix is marked with dye. The skin is dissected from the cartilage for ¼ to ⅛ inch along an incision following the marking, and a long, narrow ellipse of cartilage is removed on the scaphal border of the incision and inferiorly from the concha to reduce the size both of the concha and of the ear itself. The scaphal cartilage is then allowed to slip over the concha, so that it rests upon it at a right angle. This will be possible only if the incision has extended through the entire length of the cartilage. If a sufficient amount of cartilage has been removed, no sutures are required. After removing the excess of skin along the posterior incision, the edges are sutured. The cut edge of the concha forms a new antihelix.

Becker[17] combines the method of David and Kitlowski with that of New and Erich.[9] A strip of skin about ½ inch wide is excised along the line of junction of the scapha with the concha, beginning ⅛ inch from the point where the helix is attached to the mastoid. The incision is downward to the lower limit of the cartilage. The cartilage is then exposed by undermining both borders of the incision. The line for the proposed new antihelix is marked with dye and a thin strip of cartilage ⅛ to ¼ inch wide is removed along this line through the entire length of the cartilage. When the ear is allowed to fall back without pressure, a new antihelix appears. After the skin margins have been sutured, large surgical clips are clamped over the angle of the new antihelix to hold the cartilages in position. The contour of the new ear is further supported by packing the anterior surface with pieces of sterile rubber sponge; sterile pads are placed over this and behind the ear, and the whole is covered with a firm mastoid bandage.

Author's Operation. With the patient on the operating table in the prone position, the auricle is held under tension, with a finger always held against the anterior skin surface to guide the knife and prevent skin puncture as the posterior curved incision is made. A similar incision is continued over the mastoid surface. Beginning at the upper angle of the ellipse, the entire enclosed skin is undermined with a No. 15 Bard-Parker knife. Over the mastoid undermining may be done with scissors, if desired.

When this area has been completely denuded, the exposed cartilage is removed. It is necsesary that this piece of cartilage be relatively long, as the result will not be successful if too little is removed. In doing this step, the upper and lower rims of the ear cartilage should not be included but be allowed to remain as supports for the ear contour.

During the operation, as complete hemostasis as possible is maintained. Any bleeding points are tied off and hot sodium chloride solution is used to keep the field free from blood.

The edges of the cartilage are carefully smoothed off with scissors, and the subcutaneous layers are sutured with 4 (ought) catgut and the skin margins are closed with 6 (ought) nylon.

It may be a useful suggestion here, that any pieces of cartilage which are removed should be preserved in case of need for a later operation.

A small drain is left in the lowest part of the wound. The aural fossae are painted with collodion and pledgets of cotton are placed in all the crevices to prevent accumulations of fluid and the formation of hematomas. Vaseline or boric acid gauze is packed about the entire ear; this is covered by a marine or a rubber sponge, and a mastoid dressing is applied over all.

The patient should remain flat on the back with as little movement as possible for 24 hours. At the end of this time, the dressing should be removed and the ears inspected and the drain discarded. A fresh dressing is applied, which is allowed to remain for three days; then a new dressing is applied and allowed to remain for five days. Sutures are removed after ten days.

The auricles will be flat against the head because of the pressure of the dressing. It is well to caution the patient about this, with the assurance that the ears will assume a normal position later.

If the ears finally appear to be too close to the head, the sutures can be taken out somewhat sooner.

A bathing cap is recommended to be worn at night for one or two weeks after the dressings are removed, or earmuff dressings may be used instead.

At the end of six weeks, photographs are taken to duplicate exactly those which preceded the operation.

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LXXXV

INSTRUMENTS USEFUL IN HEAD AND NECK OPERATIONS

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Anesthesia Tracheostomy Tube.—In the administration of anesthesia for operations on the pharynx or for those involving resection of the maxilla and mandible or for extensive operations on the neck, an unobstructed airway can best be safely provided by an elective tracheostomy. During the surgical procedure, an inhalation anesthetic may be administered through the tracheostomy tube or, if intravenous sodium pentothal is employed, oxygen or a supplemental anesthetic gas may also be given through the tube. Unless special provisions are made, the connection between the ordinary tracheostomy tube and the anesthesia machine constitutes a minor and occasionally a major disturbance to the surgeon.

The device shown in the accompanying illustration (Fig. 1) takes the place of the inner cannula of the standard tracheostomy tube and is so modified that a short right-angled metal tube can be adjusted snugly to it. This connecting tube is devised so as to fit a rubber tube (attached to the anesthesia hose), making a secure nexus between the inner tracheal cannula and the anesthesia machine. The construction of the special inner cannula and its connecting tube is such that the anesthetist can maneuver the anesthesia machine in any direction without requiring the surgeon to change his position or interfering in any way with the maintenance of an adequate airway. Following completion of the operation, the anesthesia tracheostomy cannula is removed and the standard inner cannula is replaced.

The anesthesia tracheostomy tube here described is available in two sizes, No. 6 and No. 12.

Laryngectomy Tubes.—It has been a time-honored practice following a total laryngectomy to plug the open end of the trachea with a tracheostomy tube which has been wrapped with vaseline gauze so that secretions are prevented from dribbling into the trachea.

From the Head and Neck Service, Memorial Hospital, New York.

Fig. 1.—Anesthesia tracheostomy tube with special inner cannula and detachable connecting tube. The cannula here shown takes the place of the ordinary inner cannula of a standard tracheostomy tube. By means of the short right-angled tube a firm, safe, and maneuverable connection can be provided between the airway and the anesthesia machine.

and a lumen of adequate size may be maintained during the postoperative period. The tube shown in the accompanying illustration is called a laryngectomy tube, as distinguished from the conventional widely used tracheostomy tube (Fig. 2). It has several advantageous features which are not obtained with a standard tracheostomy tube and which make it distinctly more suitable for the immediate postoperative period in laryngectomized patients.

After the transected trachea has been pulled up and forward to be anchored to the skin above the suprasternal notch (tracheal stoma), its arc is changed so that the tube hitherto employed does not conform to this anatomic alteration. Further, the maintenance of an adequate lumen by the use of a No. 6 standard tube wrapped in vaseline gauze is objectionable since such a tube cannot be cleaned often without changing the vaseline gauze and the ointment occasionally has an undesirable macerating effect on the delicate respiratory mucous membrane, thus interfering with healing of the mucocutaneous suture line. The unnecessary length and excessive curve of the standard tube irritates the sensitive tracheal mucosa unduly, frequently causing cough and increased postoperative discomfort.

Our laryngectomy tubes were devised so as to eliminate the above-mentioned objections to the ordinary tracheostomy tube when used in laryngectomized individuals. They are shorter and vary in size from 8 to 12 millimeters. The arc is somewhat flatter than in the conventional tube and the base plate is placed at a sharper angle. The No. 12 laryngectomy tube, which is used in most of our patients

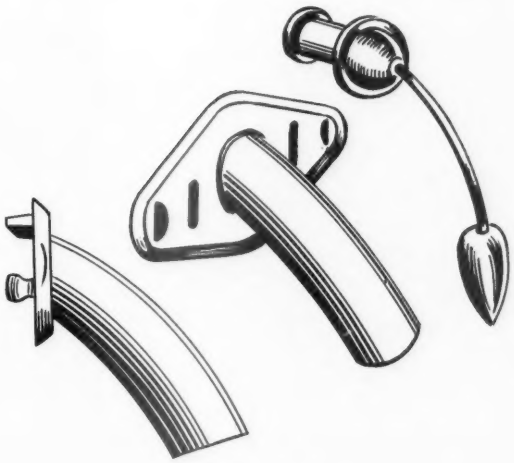

Fig. 2.—Laryngectomy Tubes. These tubes are useful during the postoperative period in laryngectomized patients and eliminate the objectionable features of the conventional widely used tracheostomy tube wrapped in vaseline gauze. The laryngectomy tube is shorter, the arc is flatter, and the base plate is placed at a sharper angle than in the standard tube. They vary from 8 to 12 millimeters in size. This device maintains an adequate lumen, prevents dribbling of secretions into the trachea, does not irritate the tracheal mucosa, and can be cleaned often with ease.

immediately following removal of the larynx, fits snugly without the addition of a layer of vaseline gauze, so that the lumen is adequately maintained and dribbling of secretions into the trachea prevented. If the stoma shrinks unduly, one of the smaller sized laryngectomy tubes may be used.

Beaded-Tip Scissors.—In partial laryngectomy (laryngofissure), after the cartilage has been split in the midline by the motor saw, a stab wound is made in the cricothyroid membrane through which scissors are inserted in order to completely partition the laryngeal box and its underlying attached mucous membrane. The ordinary scissors are not sufficiently blunt for this purpose and the vocal cords or a fragile tumor might be lacerated by the blade.

Using the old principle of the ordinary bandage scissors, the instrument shown in Fig. 3 was devised to prevent such trauma to the contents of the laryngeal cavity. The beaded end of one of

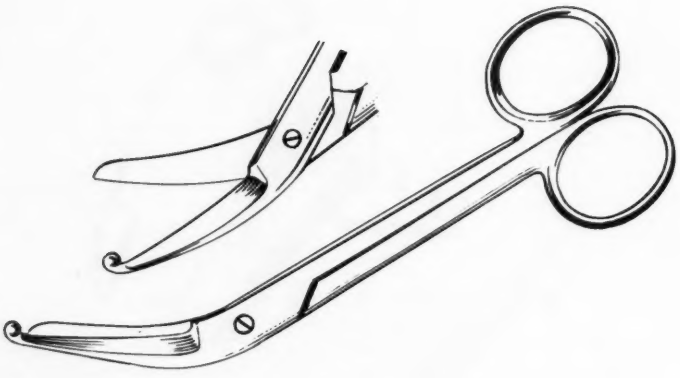

Fig. 3.—Beaded-tip Scissors. In partial laryngectomy (laryngofissure), this instrument is useful in avoiding injury to the vocal cords or the underlying growth. When the laryngeal box has been split by the motor saw, the scissors are inserted through a stab wound in the cricothyroid membrane to complete division of the soft tissues. The beaded end of the blade precludes injury to the vocal cord or the growth in its vertical passage up the glottis.

Fig. 4.—Double-pronged Cartilage Retractor. This instrument provides for firm purchase on the thyroid ala so that rotation of the larynx from side to side during total laryngectomy can be accomplished without significant trauma.

Fig. 5.—Tumor Screw. A spiral screw which is useful during removal of cartilaginous mixed tumors of the parotid salivary gland. After its introduction into the growth, steady upward traction on the mass may be obtained with this instrument.

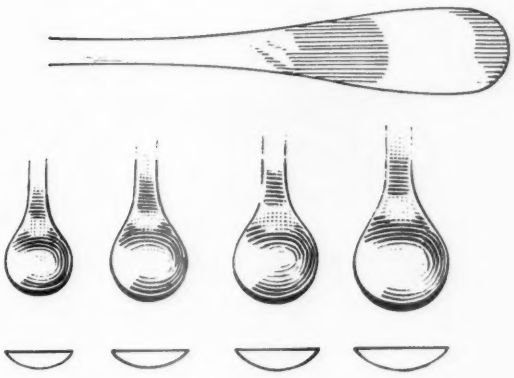

Fig. 6.—Spoon Curettes. A series of variously sized, blunt, shallow spoons designed to provide for nontraumatic retraction during removal of tumors of the parotid salivary gland. They are also useful to curette certain tumors of the antrum and the nasal cavity.

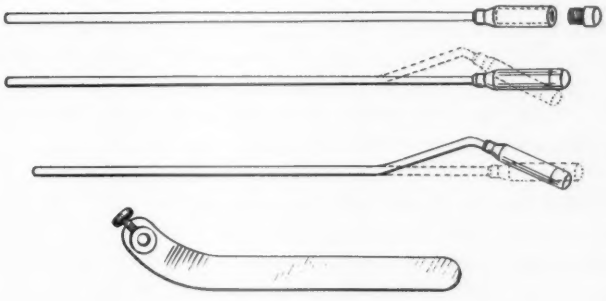

Fig. 7.—Nasopharyngeal Radium Applicator. A useful device for delivering intracavitary radiation to the nasopharynx. It consists of a capsule of nickel silver (detachable screw end) attached to a malleable copper rod which facilitates positioning of the capsule in the nasopharynx.

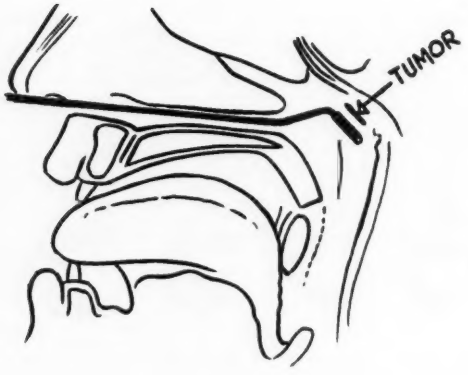

Fig. 8.—Nasopharyngeal Radium Applicator. Diagram in coronal plane showing position of the capsule in the nasopharynx.

the blades precludes any injury to the vocal cords or the growth in its passage up the glottis.

Double-Pronged Cartilage Retractor.—During total laryngectomy, mobilization of the larynx necessitates rotation of the larynx from side to side without producing significant trauma. The double-pronged retractor shown in Fig. 4 may be applied to the ala of the thyroid cartilage and provides firm purchase for retraction and rotation. With this instrument, these maneuvers may be carried out efficiently and relatively atraumatically.

Tumor Screw.—Certain firm dense growths, such as cartilaginous mixed tumors of the parotid gland, have a consistency which permits the introduction of a spiral screw after the external surface of the mass has been sufficiently exposed. Similar instruments have long been used to assist in the removal of deeply embedded fibrous tonsils. In most parotid tumors, the greater portion of the growth is actually buried within the substance of the gland, which is a relatively immobile structure. The tumor screw shown in Fig. 5 enables the operator to secure firm purchase on the growth so that it can be pulled up from its surrounding adherent bed of salivary tissue. By maintaining this continued traction, a cleavage plane may more easily be found and the tumor delivered steadily as the dissection proceeds.

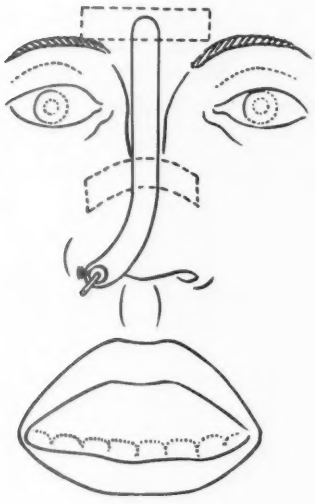

Fig. 9.—Nasopharyngeal Radium Applicator. The end of the rod which protrudes from the anterior naris is fixed by an adjustable set-screw and malleable strip and fastened to the bridge of the nose by an adhesive strip.

Spoon Curettes.—Some years ago the author, desiring an instrument to provide blunt nontraumatic retraction during removal of tumors of the parotid salivary gland, found a workable substitute in the ordinary teaspoon. The idea proved so satisfactory that he had his mechanic construct a series of "surgical spoons" (Fig. 6) cut in graded sizes from the ordinary dessert spoon, so that they are blunt and shallow. The instruments may also be used as curettes to assist in the removal of certain growths of the antrum and nasal cavity and medullary tumors of the jaws.

Nasopharyngeal Radium Applicator.—In the treatment of cancer of the nasopharynx the main reliance must be placed upon irradiation given through the cheeks anteriorly or laterally, although a moderate dose of radiation by intra-cavitary radium (or radon) is essential both to obtain the best results and to avoid the untoward effects of otherwise necessarily heavy dosages of external irradiation.

The radium applicator illustrated in the accompanying diagram (Fig. 7) consists of a capsule and a detachable screw tip of nickel

silver with a wall thickness of 0.8 millimeters (equivalent to 0.8 millimeters of brass) attached to a copper rod. This rod is malleable and allows bending in one or more curves so as to facilitate the desired positioning of the capsule in the nasophrynx. The applicator is filled with either radon seeds (filtration of 0.3 millimeters of gold) or radon tubes (filtration of 0.5 millimeters of platinum).

Once all adjustments have been made and the upper respiratory passages have been cocainized, the capsule is inserted through the anterior naris and nasal cavity into the nasopharynx (Fig. 8). The position of the capsule is then inspected with a laryngeal mirror. When the operator is satisfied with the position of the capsule in relation to the lesion in the nasopharynx, the end of the rod which protrudes from the anterior naris is fixed by an adjustable setscrew and malleable strip and fastened to the bridge of the nose with adhesive tape (Fig. 9).

These instruments are manufactured by the United Surgical Supplies Company, New York, N. Y.

737 Park Avenue.

LXXXVI

THE PATHOLOGY OF NASAL POLYPS AND RELATED GROWTHS

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The impression is prevalent that all nasal polyps are allergic in origin. This is an exaggeration but the opinion is uniformly shared by many of the younger surgeons. Kern and Schenck[1] state, "allergy is constantly a factor in the causation of nasal mucous polyps," but there are other types of nasal polyps that have a nonallergic background and whose management requires nasal surgery.

Mucous polyps of the allergic variety are usually pedunculated and found most frequently in the middle nasal meatus, either originating from the ethmoid membrane or the middle turbinate (Fig. 1). The age of the polyp determines its color and consistence. The epithelial covering is stratified squamous or columnar. The stroma is very loose and liberally infiltrated with exudate containing a few mononuclear cells, both large and small, the latter chiefly plasma cells. The number of eosinophiles varies and in polyps removed during an allergic attack will be numerous; whereas, another polyp removed from the same nose during a quiescent state will be free of them. All allergic patients do not develop nasal polyps. Many hay fever sufferers go for years untreated and when the season ends their nasal membrane returns to normal; whereas, the patient with vasomotor rhinitis, who is sensitive to dust and fungi and whose system is also disturbed by foods, constantly possesses them. The younger the individual, the more difficult it appears to be to prevent their recurrence and in the author's experience the incident of fatal complications has been among young subjects.

Inflammatory polyps differ from the mucous type in that they contain less exudate and their cells are predominatingly polymorphonuclear leukocytes. Their distribution is not limited to the middle meatus as they may be found in the superior meatus. In this position they are dangerous, as their removal may open an atrium into the

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Read before the American Laryngological Associatoin, St. Louis, Mo., April 23, 1947.

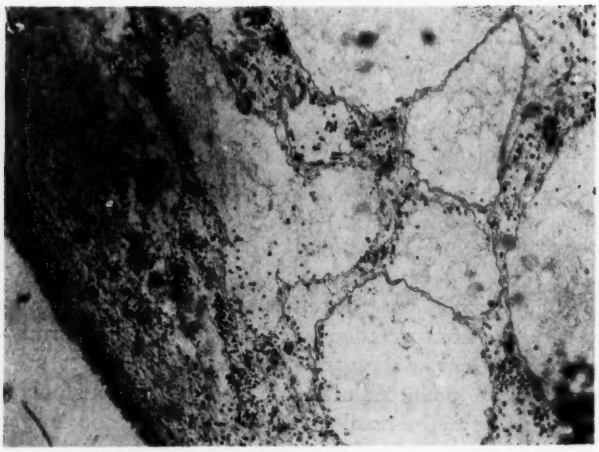

Fig. 1.—Photomicrograph of allergic polyp, high power.

cranial fossae. These polyps are the result of vascular changes induced by chronic sinusitis. The inflammation is about the blood vessels producing a periphlebitis or a perilymphangitis.

CASE 1.—W. R. B., aged 26, was admitted to the hospital in an unconscious state, with the history of having been found at the foot of the stairs of the University Infirmary. The lad had a cerebrospinal rhinorrhea and signs of an active meningitis. Apparently he had become dizzy and while going to the bathroom had fallen down the stairs. At autopsy there was an inflammatory polyp in the superior meatus which had ruptured through into the anterior fossa of the cranium and was the cause of the headache for which he had entered the infirmary.

The predominating pathological type of tissue differentiates the hemangioma from the lymphangioma. The vessels anastomose freely. Simple angiomas are located on the hard palate, the tongue or the nasal septum. The polypoid type is pedunculated and lobulated. The lymphangiomas are frequently cystic, the endothelial hyperplasia being characteristic.

CASE 2.—V. F., aged 12, presented himself with a tumor that had eroded through the palate. His history was that for the past year he had had increasing blockage of the right naris and one month

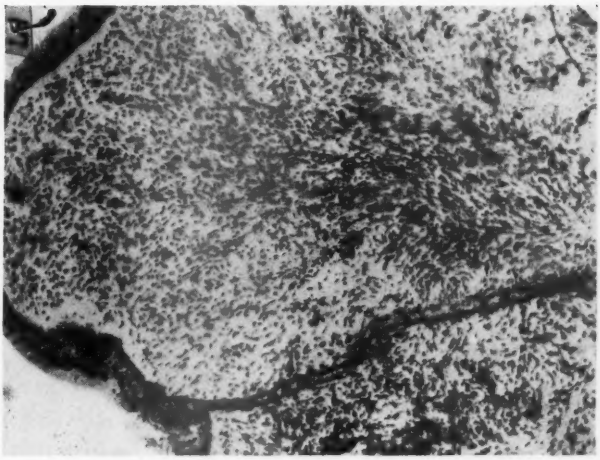

Fig. 2.—Photomicrograph of fibrous polyp. The overlying respiratory epithelium is well preserved. The cilia are distinct. The dense cellular stroma of the polyp is made up of fibroblastic cells with a few scattered round cells. The fibroblasts are arranged in definite whirls and bundles.

before admission noticed the bulging of his palate, with finally an erosion of the tumor into his mouth. The tumor originated from the posterior ethmoid cells.

The pathological report was: "Section showed many large empty spaces lined by endothelial cells. In places there is marked hyperplasia of these cells merging into the stroma. The covering epithelium is hyperplastic. Diagnosis—lymphangioma."

CASE 3.—B. M., aged 16, complained for one year of progressive nasal obstruction. Examination showed the right naris filled by a polyp with a cyanotic hue, attached posteriorly to the middle turbinate. Microscopic examination showed: "Many vascular spaces scattered throughout the section. The cells are large and small monocytes. Diagnosis—hemangioma."

The mulberry polyp is found on the posterior end of the inferior turbinate and consists of a hyperplasia of the turbinate tissue. Its glands are cystic and its blood vessels dilated.

In regard to pressure polyps, when the septum is deflected to impinge on the middle turbinate, sufficient pressure may be exerted

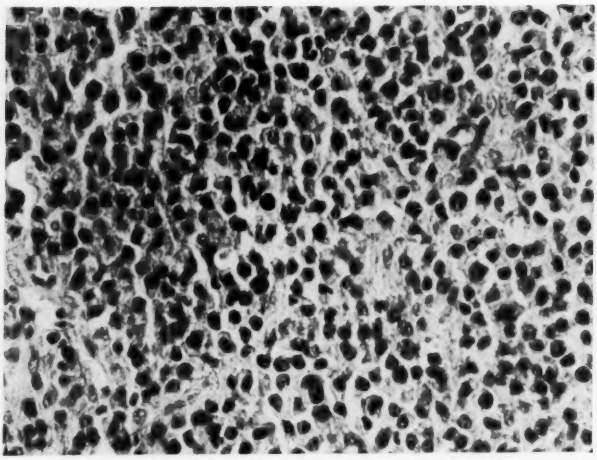

Fig. 3. Photomicrograph of plasmocytoma—section showing center of tumor. Numerous large hyperchromatin cells and many mitotic figures are seen. The nuclei are eccentrically placed.

upon the ethmoid capsule to cause a stasis of circulation and, as Woakes[3] stated, produce a necrotizing ethmoiditis with the formation of polyps. The majority of solid tumors of the antrum are accompanied by ethmoidal polyps.

CASE 4.—Mrs. J. H., aged 22, had an adamantinoma of the antrum. The middle meatus was filled with polyps. The pathology of these pressure polyps is similar to that of the mucous type, but their blood vessels are dilated and areas of necrosis appear throughout the polyp.

Choanal polyps arise either within the maxillary sinus or from the nasopharyngeal wall. The polyp is unilateral and becomes apparent when its size is a nuisance. Its epithelial covering is stratified squamous and its consistence solid. The blood supply is rich and any glands present are dilated. If the polyp originates from the maxillary sinus, the attachment is immediately within the sinus close to the ostium and best removed by a transantral approach. Those attached to the lateral wall should be removed by avulsion or destroyed by radium implants (Fig. 2).

CASE 5.—S. J., aged 17, while vomiting, strangled on a fleshy mass that hung down his throat. The tumor originated within the

antrum. The microscopic report was: "The polyp is covered by a hyperplastic stratified squamous epithelium. The stroma is of loose areolar connective tissue and the blood vessels are dilated at its attachment."

The rarest nasal growth is a cholesteatoma. The author has encountered one in his practice.

Some inflammations, particularly chronic ones, produce squamous metaplasia of more differentiated mucosal linings, such as the pseudostratified ciliated columnar lining in the respiratory tract. Vitamin A deficiencies are capable of producing essentially the same type of metaplasia. This metaplastic process is usually focal but may be diffuse. With the addition of layer upon layer of squamous epithelium a keratin layer is formed similar to that of the skin. These sloughed cells by continuing to accumulate within a closed cavity produce by pressure a bony necrosis or at least a thinning of the bone. Ulceration of portions of the metaplastic lining may occur as well as invagination; in other words, the process may assume a polypoid appearance. When such foci with their sloughing keratinous elements are present, a great deal of tissue irritation is set up. Keratin cannot be digested by the tissue juices or by the leukocytes brought to the scene in the inflammatory process. Disintegration may occur around the deposits of sloughed keratin, or the disintegration products which are chiefly cholesterol will set up a foreign body giant cell reaction. This granulomatous response may be widespread and in turn produce polypoid excrescences. The evolution of the process is either a mass of sloughed keratin accumulating within a confined space or a polyp. Nature has no tissue enzyme capable of digesting keratin.

CASE 6.—M. P. S., aged 55, underwent a radical antrum operation, during which a polyp was removed from the outer margin of the floor over the site of a recent extraction. The microscopic examination revealed a deposit of cholesterol needles seen as slit-like spaces.

Plasmocytoma is one of the rare nasal growths and of 127 reported by Hellwig[4] only 63 arose in the upper respiratory tract (Fig. 3).

CASE 7.—W. W. C., aged 43, was conscious of a bleeding growth in the right side of the nose. The tumor was fleshy in type and filled the right naris. It arose from the mucous membrane covering the septum and was very vascular. The original laboratory

report was of a lymphosarcoma. The Army Medical Museum changed the diagnosis to a plasmocytoma with the following report: "Microscopic examination reveals a section partially covered by squamous epithelium. The main bulk consists of closely packed cells which have, for the most part, eccentric nuclei and a basophilic cytoplasma. The nuclei occasionally have the appearance of a cartwheel with chromatin collected in the periphery. We believe these cells to be plasma cells. Practically no stroma is seen. The diagnosis is plasmocytoma."

The base of the tumor was thoroughly cauterized and received 100 mg. hours of radium irradiation.

Plasmocytomas are composed of extramedullary plasma cells. These cells are oval to round with an abundance of cytoplasm. Their nucleus is eccentrically placed with a small central nucleolus and the chromatin arranged like a cartwheel. Inasmuch as plasma cells are members of the hematopoietic group, these tumors are true myelomas and repeated roentgenograms should be made of the osseous system.

All polyps removed should be studied, as they can become malignant on recurrence.

CASE 8.—Mr. T. J. S., aged 58, had polyps first removed in 1926. Yearly thereafter he presented himself for their removal and in 1942 the polyps were diagnosed as transitional cell carcinoma.

CONCLUSION

The majority of nasal polyps are allergic and simple, but there are a sufficient number of serious growths to justify a thorough microscopic study of all polyps removed.

1018 MADISON AVENUE.

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The Scientific Papers of the American Broncho-Esophagological Association

LXXXVII

THE SURGICAL TREATMENT OF POSTCRICOID AND CERVICAL ESOPHAGEAL CARCINOMA

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The malignant tumors found in the postcricoid and cervical esophageal regions are usually epidermoid carcinomas, but adenocarcinoma does occur fairly often in the upper esophagus, and other rare tumors have been reported. Because of the anatomy of this area a more difficult problem is faced in their management than when these same tumors are found either primarily within the larynx or lower down in the esophagus.

During the past five years we have treated 13 patients whose tumors were in these regions. In the postcricoid group were four men and three women. All of these tumors were epidermoid carcinoma. In the esophageal group were two men and four women. Five of these tumors were epidermoid carcinoma and one was adenocarcinoma. Although these tumors are listed as postcricoid or esophageal in origin, both structures were frequently involved and at times in the more advanced cases it was difficult to determine the origin of the tumor.

Dysphagia was the most frequent symptom and had been present for from two to twelve months, the average duration being seven months. Hoarseness was rare except in advanced and extensive postcricoid tumors. Pain in the throat, chest and back was noted, as well as reflex pain to the ear. There was a recurrent laryngeal nerve paralysis in one case.

From the Department of Otolaryngology, University of Virginia Hospital, Charlottesville, Va.

Mirror examination was negative except in those cases in which the growth had extended up into the hypopharynx or laryngeal extension was sufficient to produce fixation of one or both arytenoids. In these cases, local edema was often present. Direct examination was necessary in order to visualize the tumor and to secure biopsy specimens. However, in several cases of esophageal tumor direct examination was unsuccessful and external cervical exploration was employed to secure tissue for biopsy and to determine the extent of the tumor.

Lateral neck roentgenograms and fluoroscopic study with an opaque mixture are valuable and necessary.

After these preliminary studies and consideration of the type, extent, and grade of malignancy, a plan of treatment is outlined, which is based upon whether the tumor is considered to be incurable or possibly curable. To determine this point, the following procedures have been employed: Direct examination of the larynx and esophagus; roentgenograms of the neck and chest; surgical exploration of the neck and occasionally of the abdomen, in order to determine the location and extent of the tumor, the presence of metastases, and to secure biopsy specimens.

When the tumor is believed to be incurable or inoperable, because of the patient's age or general condition, gastrostomy and tracheotomy may be done as a palliative procedure and palliative radiation therapy employed.

When the tumor is considered possibly curable and the patient consents to operation after a frank discussion, its surgical removal is planned, for radiation therapy alone has proven inadequate in our hands. However, radiation therapy is used for palliation in the inoperable cases, and in curative doses in the operable cases subsequent to surgical removal. Until some more specific treatment for carcinoma becomes available, wide surgical removal followed by radiation therapy offers the best hope of cure in these cases.

In the case of postcricoid carcinoma, regardless of the voice a wide and complete laryngectomy is done, and a wide segment of the hypopharyngeal mucosa and upper esophagus is removed en bloc; however, if possible, a strip of the posterior esophageal wall is left and sutured around the feeding tube. If this can be done, a functioning gullet can be maintained; if not, the hypopharyngeal mucosa is sutured around a tube and brought out toward the skin through a counter opening in order to create a fistula. The upper end of the esophagus is likewise brought out through a counter opening usually

made through the sternomastoid muscle in its lower portion. A feeding tube inserted into the esophagus here obviates the necessity of a gastrostomy. Fractional dose roentgen ray radiation is then employed up to toleration of the patient. If an apparent cure is obtained and there is no evidence of recurrence nor of metastases in one year, a plastic reconstruction of the upper esophagus may be considered. Movable metastatic cervical glands are removed surgically; otherwise, radiation is relied upon.

When the upper esophagus is removed, the development of a buccal voice cannot be anticipated and an artificial larynx must be provided. At times the pharyngeal fistula can be connected with the upper esophageal stoma by an extracervical tube. This provides for the disposal of pharyngeal secretions and furnishes the necessary saliva for digestion.

When cervical extension has taken place, it is resected surgically along with the regional lymph nodes, when mobile. Fractional roentgen ray radiation is always employed, after healing is well established, up to the tolerance of the patient, usually 6000 to 8000 r.

The problem encountered in upper esophageal carcinoma is somewhat different from postcricoid carcinoma, since the larynx may or may not be secondarily involved.

When the new growth in the esophagus extends downward into the mediastinum, the patient is referred to the chest surgeon for operation by means of a transthoracic approach. However, if the lesion is limited to the cervical esophagus and an adequate lower segment free of tumor is obtainable, this lower segment is brought out after section through a counter opening through the sternomastoid muscle. The esophagus is then removed from below upward. When adjacent structures such as the larynx or thyroid or regional nodes are involved, they are also removed en bloc. In either case a pharyngeal fistula is established and subsequent roentgen ray radiation is carried out, up to toleration of the patient.

RESULTS

In the group of 13 patients, two cases were considered inoperable, because of metastases to the lung in one and to the lung and abdomen in the other. Gastrostomy and palliative radiation alone were employed.

Two other cases were considered inoperable because of the age of the patients (79 and 80 years respectively) and their poor general

condition. However, the tumors in both of these were surgically operable. One was treated by roentgen ray radiation, and the other, who had a relatively small tumor on the posterior wall of the upper esophagus, was treated by palliative radon implants. Radium or radon, when employed, must be used cautiously because of the danger of perforation. Both had gastrostomies.

Three patients, who were considered to have operable lesions, refused operation, after frank discussion; one returned in six months and asked for operation because of pain. However, it was then too late. They all had palliative roentgen ray radiation and gastrostomies and tracheotomies when necessary.

One patient had a very extensive involvement of the larynx and upper esophagus and was treated entirely by radiation. This was followed by necrosis and suppuration of the laryngeal cartilage and subsequent pulmonary suppuration. This experience corroborated our previous experience in the radiation treatment of advanced cancer of the larynx, for when a tumor has invaded the lymphatics and wide portals of treatment are necessary, radiation edema is prone to occur, which necessitates tracheotomy. Since infection so often follows, chondritis and necrosis occur and death usually comes from lung suppuration or hemorrhage.

All eight patients in this group died from the disease.

Five patients were operated upon:

Case 1, a patient with a postcricoid carcinoma subsequently died from esophageal extension which was not observed at the time of operation, and although this fact was noted in the examination of the specimen in the Pathological Department, their report was not seen by me until the patient presented evidence of extension six months later. Additional radiation then did not alter the course of the disease.

Case 2, a patient with a postcricoid cancer, subsequently succumbed to extensive and widespread cervical metastases, and although a block dissection of the neck was attempted, the tumor was found to have invaded the carotid artery. Additional roentgen ray radiation of the neck was then employed. However, the patient died from the disease.

Case 3, was a patient with an extensive postcricoid growth with fixation of the arytenoids and edema. A laryngectomy and removal

of the esophagus except for a posterior strip was done, followed by radiation. This patient died six months later of a cerebral hemorrhage. He had only slight dysphagia and autopsy showed no evidence of local or metastatic recurrence.

Case 4, a patient with an upper esophageal epidermoid carcinoma, who had a laryngectomy, resection of the entire upper esophagus and left lobe of the thyroid, plus roentgen ray radiation, is now living without evidence of recurrence after seven months.

Case 5, a patient with an upper esophageal epidermoid carcinoma, who had a laryngectomy and complete resection of the upper esophagus, plus radiation, is now living and apparently well four years after operation.

CONCLUSIONS

Wide surgical excision of these tumors and adjacent structures when necessary, followed by roentgen ray radiation, offers the only hope of cure at this time. Although one hesitates to carry out such mutilating procedures, in which both the larynx and the esophagus are frequently removed, our three surviving patients were happy and led useful lives. One died six months after operation from a cerebral hemorrhage at the age of 77.

The second living patient is 43 years of age and is apparently well.

The third patient, aged 49, is living and well after four years. She is happy and in good condition, and we are now contemplating a plastic operation to restore the esophagus.

Cases of malignant tumors of these areas have been reported as cured by radiation. However, our experience with radiation alone has been an unhappy one, so at the present time I advocate wide surgical excision of the tumor and adjacent structures as well as movable cervical glands, in spite of the mutilation necessitated by such a procedure. The operation is then followed by fractional dose radiation up to full toleration by the patient, usually 6000 to 8000 r, through adequate portals. Since the cartilaginous structures have been removed, there are no contraindications to full dosage. The tumor itself must be reasonably operable, the age and general condition of the patient must be considered, and his consent obtained after a frank discussion. To say that these patients are unhappy or life is burdensome with their handicaps is unjustified in our experi-

ence—and until a more specific method of treatment of carcinoma presents itself, I will continue to advocate wide surgical removal, followed by radiation therapy in selected patients, in an effort to effect a cure.

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LXXXVIII

CARCINOMA OF THE ESOPHAGUS

AN ANALYSIS OF 145 CASES WITH SPECIAL REFERENCE TO METASTASES AND EXTENSIONS

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In 1935, in a report on 506 patients with carcinoma of the esophagus observed at Memorial Hospital in New York over the 13-year period ending in 1931, Watson[1] made the statement that a cured case of this disease is a medical curiosity and that it seemed wise, in view of its rapidly fatal character, to attempt cure only in the very few favorable cases and to treat the remainder routinely by palliative methods. In 1942, in a review of 930 cases of carcinoma of the esophagus, this same observer[2] stated that after 15 years' experience with the disease he had become considerably more optimistic about it. The reason for his optimism was twofold: the method of external radiation carried out for the previous two years at Memorial Hospital and the recent advances in transthoracic esophagogastrostomy and esophagogastrectomy. In 1945 Sweet[3] put on record 72 radical resections followed by some form of anastomosis for carcinoma of the esophagus. The most significant feature of his report was that, while only one of these operations had been performed in 1939, 34 had been performed in the first ten months of 1944. Since that time Sweet has materially increased the number of his own cases, and numerous other surgeons have put on record many other cases in which curative operations were performed.

These observations indicate that the professional pessimism with which carcinoma of the esophagus was once viewed has over the past

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decade become a modified and cautious optimism. "Cured" patients perhaps are no longer rare but they remain exceedingly uncommon. Radical resections, however, are no longer surgical curiosities. They have become standard procedure, in fact, in every case that is not frankly hopeless, for two very good reasons, namely, the remarkable recent advances in intrathoracic surgery, and the completely justifiable position that if a disease is hopeless without treatment almost any risk that offers a chance of salvage is worth the taking.

The general situation, of course, is nothing like as bright as these facts might suggest. The outlook on carcinoma of the esophagus has changed, it is true. Technical advances in both surgery and radiation therapy have made cures of the disease at least theoretically possible. Surgical courage, allied with surgical judgment, has extended the indications for resection while at the same time the mortality, although still not small, is no longer prohibitive. But to the great majority of patients with carcinoma of the esophagus these brilliant advances mean nothing. The disease in most cases is still detected too late to permit any but palliative treatment if indeed to permit any treatment at all.

The figures which we are presenting in this communication make that situation only too clear. During the 11-year period ending December 31, 1946, 132 indubitable cases of carcinoma of the esophagus were observed at Charity Hospital of Louisiana at New Orleans (Table 1). Another 13 indubitable cases were observed over the same period at the Hotel Dieu Sisters' Hospital in the same city. At Hotel Dieu, which receives private patients, exploration was done in one case, which was found to be inoperable. At Charity Hospital (Table 2), which receives only indigent patients, 18 operations were done with the expectation of resection and 24 patients were treated with radiation. Seven patients were found to have inoperable growths (Table 3). Of the 11 on whom resection was carried out, eight did not survive the immediate postoperative period (Table 3) and one died of recurrent disease in three months. The other two patients may or may not still be alive; both were lost from observation at the end of a year. Among the patients treated with radiation six of 13 in whom cure was attempted are alive from nine months to 18 months after treatment.

The two surgical patients who may be alive and the six patients still alive after radiation therapy represent the total salvage in these 145 cases. Death occurred in 70 patients while they were under observation. It has inevitably occurred, or will occur, in all the

remainder except, possibly, the eight just mentioned. Some of them were near the end of the road when they were discharged from the hospital for the usual cruelly kind reason—to make way for patients for whom something could be done. For others, the end may have seemed a little farther off, but only the same outcome could be anticipated. There can be no other in carcinoma of the esophagus when radical surgery has not been done or, perhaps, when radiation therapy by the new technique has not been applied. Many of the patients last seen alive had been submitted to gastrostomy, 72 such operations being done in the combined series, but that procedure can do nothing but make the end easier or make it come more rapidly, depending upon one's point of view.

That is the tragic clinical picture of the type of cancer which ranks fourth in males beyond 20 years of age and which accounts for at least eight per cent of all deaths from malignant disease. The bulk of the cases occurred, it is true, in a large public institution, but the situation was no brighter at the private hospital. The number of cases was smaller there, which would be expected, for this is a disease which is thought to be more frequent in lower social and economic levels.[1, 4] But the patients' disease was no less advanced when they were first seen. It must not be forgotten, moreover, that this analysis concerns only the proved and clinically indisputable cases (124) at these two institutions. There is much more to the picture. For one reason or another we discarded 85 additional cases which were almost certainly carcinoma of the esophagus, as well as numerous others in which the disease was merely suspected though often with very good reason. Nor does this report take any account of the numerous cases in which carcinoma of the esophagus was not even suspected. That such cases exist is shown by the fact that in four of the 44 autopsied cases in this series there was no suspicion of carcinoma of the esophagus until it was discovered in the autopsy room.

Regarding sex, age and race, the statistics from Charity Hospital do not vary greatly from other reported statistics. The lesion, as usual, was predominantly one of the male sex (Table 4), although there was a considerable predominance of females in the hospital admissions (Table 1). It was also, as usual, predominant in middle life and later (Table 4). Approximately 90 per cent of the patients were over 40 years of age, though the range was from 30 to 84 years and six patients were in the thirties, of whom one was 30 and one 33 years of age. There is nothing new in this observation, but it is worth pointing out again that this disease, as other malignant dis-

eases, does occur chiefly in the older age groups but it can occur, and must be looked for, in very much younger persons. It is also worth commenting on that the age incidence in negroes was somewhat lower than in whites; many observers have the impression that malignant disease tends to occur at a somewhat earlier age in the colored race.

Approximately 60 per cent of the cases at Charity Hospital occurred in the negro race (Table 4), which at first glance is striking and unusual. So far as reported cases are concerned, it *is* unusual. Most series mention only two or three cases in negroes, if any at all. From the standpoint of proportionate distribution, however, the racial incidence is about what might be expected. One reason is that the hospital admissions, which for many years had been approximately 55:45 in favor of the white race, for the last four or five years have been in favor of negroes in about the same ratio (Table 1). The explanation of the declining white admissions is undoubtedly the greater prosperity of the war years, which has reduced the number of indigent white patients. The second reason for the apparent negro predominance is that members of this race in Louisiana, although they also are now better off, have almost nowhere else to go except to public institutions. The only institution in New Orleans other than Charity Hospital to which they can be admitted is a private hospital where the total number of beds is about a hundred.

It seems worth emphasizing here that the large number of negro patients is no explanation for the poor results in this series. It is difficult to reduce such data to statistics, but an analysis of these cases shows that negroes, patient for patient, delayed no longer than whites in seeking relief of their symptoms, that they were in practically the same condition—which was usually poor—as the white patients, and that they presented no lower resectability and no more complications than did the white patients. These points are worth emphasizing, since in many other diseases at the New Orleans Charity Hospital the predominance of negro patients is invoked, and usually with good reason, to explain poor results.

The regional distribution of cases (Table 4) also presents nothing out of the ordinary. Roughly 13 per cent were in the upper third of the esophagus, 40 per cent in the middle third, and 47 per cent in the lower third. In the 8,572 cases collected by Ochsner and DeBakey[5] from the world literature, the respective incidences were 20 per cent, approximately 37 per cent, and approximately 43 per cent. Of the 32 cases in females, only five were in the upper third, which is in contrast to the frequent statement that most carcinomas

in females occur at this level. The average age of patients with disease in the upper third was lower by some five years than the age of patients with disease in other portions of the esophagus, but it is doubtful that any significance at all should be attached to this observation.

As in all other series, dysphagia (Table 5) was almost always the first symptom which brought the patient to the physician, though on inquiry it was found not always to be the first symptom; it was, however, present during the course of the illness in almost every case. The average duration was practically the same for all locations of the growth. The range was from one month or less in 17 patients to 18 months in one patient, a negro male with a lower third lesion; so long a duration is possible but not usual in this disease. As in all reported series, the duration of symptoms was of no great value in an estimate of the status of the disease. A scirrhous carcinoma might have replaced almost all of the esophageal wall before it encroached upon the lumen and caused obstructive symptoms, while a papillary carcinoma or adenocarcinoma might have given rise to dysphagia promptly because it encroached upon the lumen early. In this series, as in all reported series, the esophagus was almost closed in a fairly large number of cases before the patients sought medical aid, which proves again that fluids, and even well-masticated solid foods, may pass through a lumen 5 or 6 mm. in diameter.

A representative number of patients in this series, on careful questioning, could recall that substernal pain and burning after meals had preceded dysphagia. An even larger number were able to remember that dysphagia had been preceded by a cough, while in some such instances dysphagia had not developed at all. The presumable source of this symptom is diaphragmatic irritation. We have been impressed in our analysis of this series with its possible importance, and our own policy for the future will be to suggest esophagography in all patients who present a cough which cannot be clearly explained by a careful study of the respiratory tract.

A similar investigation seems warranted in instances of unexplained hoarseness, which a number of patients with lesions in the upper third of the esophagus presented as a first symptom. Hiccoughs were rather frequent when the lesion was at the cardia. Dysphagia is so generally conceived of as the first symptom of carcinoma of the esophagus that other symptoms are sometimes overlooked by physicians as well as by patients. It is well to emphasize these other symptoms and to suggest that this disease be considered

as a possibility in their evaluation; they are perhaps not frequent and they occur inconstantly, but in a disease such as this one literally grasps at straws.

In 124 of the 145 cases in this series the diagnosis of carcinoma of the esophagus was confirmed by autopsy or biopsy. The majority of cases, as is usual, were of the squamous cell variety (Table 5). In the 41 cases which were graded there was not a single instance of grade 1 malignancy, which is in accordance with the general observation that this is a tumor in which the malignant process is usually of great virulence.

Diagnosis in this series was made by the usual means, that is, roentgenograms, fluoroscopy, and esophagoscopy, usually with biopsy. The value of these methods was repeatedly proved. Some cases proved the dangers of an inferential exclusion of carcinoma of the esophagus without biopsy. Delay in such cases did irreparable harm. An occasional case proved that the physician who makes a diagnosis of globus hystericus is taking a heavy responsibility upon himself. Almost every case proved the heavy responsibility which the esophagoscopist carries in this disease.

Esophagoscopy is not a trivial procedure and the operator should prepare himself for it in every case by learning the history, examining the patient, studying the x-ray films, and, preferably, being present when the fluoroscopy is done. His examination should be complete and biopsy specimens should be taken from several different sites. This is the ideal plan of procedure, and it is particularly important in a public institution where, if patients are once given a negative diagnosis, they are likely to slip away and are brought back for further examination only with difficulty and often not until it is too late. This series proves very clearly that esophagoscopy, with biopsy when practical, is indicated in every patient who complains of the slightest abnormality on swallowing or of any other abnormal sensation related to the ingestion of food. The only contraindication to its performance, it has been well said, is lack of a trained operator to perform it.

It has already been mentioned that diagnosis was missed until autopsy in four cases at the New Orleans Charity Hospital. Each of them is instructive enough to warrant special mention:

The first patient was explored on a diagnosis of intra-abdominal cancer of undetermined origin. The liver tissue seemed almost totally replaced by metastatic malignant growths, but until autopsy

the neoplastic focus was not identifiable as the esophagus. The patient died shortly after operation of hepatic failure, which autopsy indicated was due to sheer lack of functional liver tissue.

The second patient died of cerebral metastases from carcinoma of the esophagus. A roentgenographic study of the gastro-intestinal tract, undertaken as part of a routine work-up, had been reported negative.

The third patient died of a lung abscess. He had a cough which was naturally attributed to the abscess, and the abscess itself was related to the extraction of a number of teeth just before the chest condition developed. Autopsy proved that the suppurative process arose following central necrosis in a metastatic lung tumor.

The fourth patient died of hemorrhage, presumably from a thoracic aneurysm. He had suffered from hoarseness for the past six months. Autopsy showed the hoarseness to be due to carcinoma of the esophagus and the hemorrhage to be due to extension of the disease into the aorta.

It is worth emphasizing that, while in the first and second of these cases there was nothing at all to point to an investigation of the esophagus as the source of symptoms, the cough in the third case and the hoarseness in the fourth case were possible symptoms of esophageal cancer to which, as we have already suggested, a great deal more attention should be paid.

There is no need to dwell upon the cases in this series in which dysphagia had been permitted to progress to such a degree that the patients, when they presented themselves, were emaciated and dehydrated. One need only look at the illustrations which accompany papers on carcinoma of the esophagus to realize that this is, unfortunately, the typical picture of the disease. Under those circumstances, as Watson[1] well expressed it, the diagnosis is as obvious as the prognosis is poor.

It is a commonplace observation that the chief reason why carcinoma of the esophagus is such a highly fatal disease is that its anatomic location, in the midst of important and vital structures, makes the esophagus a particularly dangerous site for a malignant process. It has no outer serosal covering and it is richly supplied with lymphatics in the submucosal and muscular coats. As a result of these favoring circumstances, the growth tends to spread longitudinally, to erode through the esophageal walls with consequent mediastinitis, and to metastasize to mediastinal lymph nodes and

other structures through the convenient lymphatic channels. An examination of the sites of metastases in relation to the anatomic locations of the lesion supplies abundant evidence of these observations (Tables 6 and 7).

In 38 of 101 patients who survived the period of observation (Table 6), metastases were identified by clinical methods in 16 different sites, including six different groups of lymph nodes. They were identified by physical examination in 11 patients, by physical examination and x-ray studies in 19 patients, and by physical examination and surgical exploration in 30 patients.

In 30 of 44 patients submitted to autopsy (Table 7), metastases were identified at autopsy in 19 different sites, including seven different groups of lymph nodes. The disparity between the sites of metastases identified by clinical methods and at autopsy indicates the number of metastases probably overlooked in the group studied only by clinical methods. Incidentally, certain of the metastases observed in this series are clarified by the recollection of Batson's[6] important study on the role of the vertebral veins in the spread of metastases.

The absence of metastases in 14 cases might suggest that operation might have been done or should have been done in some or all of these patients. The inference would not be correct. In not a single patient who was not operated on could operation have been done with any hope of success. Either the growth was not resectable, or the patient's condition was too poor for immediate surgery and seemed irreversible, or both factors were present. In some of the cases in which metastases were found, both clinically and at autopsy, operation had been undertaken in the sure belief that the growth was resectable. The postmortem observations, in short, confirm once again the unhappy circumstances that in this disease metastases may develop before clinical symptoms referable to the esophagus appear, while in other cases death occurs from inanition or cachexia or both before they develop.

In 20 patients (Table 8) the disease had extended to adjacent organs. The sites of extension numbered 12, and complications had occurred in 17 of the 20 cases. In all, metastases or extensions or metastases and extensions were identified in 88 patients. As a result, this group, which comprised 60.7 per cent of the total number, was automatically excluded from the benefits of surgery and probably, in most instances, of radiation therapy also. The corresponding figure in the autopsied cases is 81.8 per cent.

The four instances of aortic rupture should be particularly noted. According to Postoloff and Cannon,[7] who put on record two cases of their own, only 60 cases of this kind, including their own, had appeared in the literature up to 1946. Their own cases indicated that perforation occurs from interference with the blood supply secondary to thrombosis of the vasa vasorum and not from neoplastic invasion of the entire wall or from bacterial infection.

The primary causes of death (Table 9) need no extended comment. Cachexia and inanition are the commonest causes of a fatal outcome, as would be expected in a disease which interferes with the ingestion of food, while pulmonary and mediastinal complications would be expected, for the anatomic reasons already discussed, to be the next most frequent causes.

Although the purpose of this communication is not to discuss therapy, a few words might be said about certain aspects of it, since, after all, all that has already been said is important only in relation to what can be done for the patient.

The surgical concept of the future will be based on whether or not the neoplasm is intrathoracic or extrathoracic. Lesions of the intrathoracic portion of the esophagus are amenable to resection and reestablishment of continuity of the gastro-intestinal tract by bringing the stomach (or a loop of jejunum) into the thoracic cavity. Lesions of the extrathoracic portion of the esophagus can be treated by resection and reestablishment of gastro-intestinal continuity by bringing the stomach or a loop of jejunum through the dome of the thorax into the neck and anastomosing it to the stump of the esophagus. The latter technique eliminates the numerous types of antethoracic reconstructive procedures formerly in use, most of which are tedious and difficult and all of which are invitations to fistula formation and subsequent stenosis. The advanced state of most of the lesions in this series unfortunately makes this phase of our discussion almost entirely academic.

An unfortunately large number of the cases in this series furnish clear proof that unless gastrostomy is performed early while the patient, even if his growth is inoperable, is still in relatively good condition, there is little point to performing it at all. It merely prolongs for a short time a life that is not worth the living. Our own opinion, as already intimated, is that gastrostomy is very seldom a desirable procedure. We share the opinion of Vinson[8] that better results can be secured by dilatation in inoperable cases. The procedure is not uncomfortable if a previously swallowed silk thread is

used as a guide to the dilators, and the patient's state is far better, for a longer period of time, than when gastrostomy is employed.

Radiation therapy with new techniques seems to offer more hope than it formerly did. Buschke and Cantril[9] only recently have reported their experiences with 14 cases, only six of which could be regarded as in any way favorable. Two of the six patients were alive and well at the end of two and seven years respectively, which for carcinoma of the esophagus is a remarkable record indeed. According to Garcia,[10] in charge of radiotherapy at the New Orleans Charity Hospital, the fact that six of 13 patients at that institution in whom cure was a possibility (Table 3) are alive and well for periods varying from 9 to 18 months after treatment, may be regarded as very hopeful. The technique used, devised by Smithers and his associates,[11] permits the delivery of an average dosage for tumors to involved segments of the esophagus; it is particularly effective in lesions of the middle third, which from the standpoint of surgery are most difficult to treat. All radiotherapists warn that this method carries a certain mortality, because of the risk of perforation into the great vessels or the mediastinum, and they also warn that the patient, while under treatment, should be very carefully observed, preferably in a hospital, and should be given supportive treatment including blood transfusions. The number of cases treated by radiation therapy with favorable results is still much too small at Charity Hospital, as elsewhere, to warrant optimism, but certainly they warrant the continued use of this method with curative as well as merely palliative intent when for valid reasons surgery cannot be performed.

SUMMARY AND CONCLUSIONS

A study of 145 cases of carcinoma of the esophagus, 124 proved by postmortem examination and the remainder indubitable instances of the disease, shows the usual gloomy picture of advanced processes, widespread metastases and extensions and nonresectability, and the almost 100 per cent mortality characteristic of most reported series. Two patients who had radical operations were alive when last seen at the end of a year, but have been lost from sight. Six patients who had radiation therapy by a new technique have been kept alive from 9 to 18 months. All the other patients in the series are either dead or have no hope of survival because they were not submitted to any procedure which gave them any chance of life.

The duration of symptoms in this series ranged from less than a month to 18 months (in a single, possibly questionable case). The

average duration was less than five and a half months. Yet metastases were identified by clinical methods in 16 different sites in 38 patients who survived the period of observation and they were identified at autopsy in 19 different sites in 30 of 44 autopsied patients. In addition, extension of the malignant process was identified in 12 different sites in 20 patients, 17 of whom presented complications in the sites to which extension had occurred. A total of 88 patients, 60.7 per cent of the whole series, was thus eliminated from all hope of cure by surgery, because in this disease radical surgery is for all practical purposes contraindicated in cases in which metastases and extensions have occurred. It seems doubtful that radiation therapy, even by new methods, can achieve anything at all in such cases.

The solution of the problem of carcinoma of the esophagus in the general run of cases still seems very far off. Advances in surgery and in radiation therapy are applicable only to the small and highly favored group of patients whose disease is recognized early enough for these measures to be useful. Hope for the rest lies in the recognition by physicians in general that even the most trivial symptoms which might point to the disease must be fully and repeatedly investigated. Since esophagoscopy and biopsy are the definitive diagnostic methods, the responsibility of the esophagoscopist for the end-results in this disease is correspondingly heavy.

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TABLE 1.—OCCURRENCE OF CARCINOMA OF THE ESOPHAGUS IN TOTAL ADMISSIONS TO CHARITY HOSPITAL, NEW ORLEANS, LA., PERIOD 1936-1946.

RACE	SEX	TOTAL ADMISSIONS	CARCINOMA OF ESOPHAGUS TOTAL CASES	PER 100,000
White	Male	131,797	44	33.4
White	Female	144,309	11	7.5
White	Both	276,106	55	12.7
Colored	Male	125,077	58	46.3
Colored	Female	185,556	19	10.2
Colored	Both	310,633	77	24.7
Both	Male	256,874	102	39.7
Both	Female	327,865	30	9.1

TABLE 2.—TREATMENT.

SITE	X-RAY	GASTROS-TOMY	THORACIC SURGERY	JEJUNOS-TOMY	LAPARO-TOMY	SUPPOR-TIVE
Upper Third	4	9	0	0	0	9
Middle Third	13	30	9	0	0	23
Lower Third	7	30	9	3	1	17
TOTAL	24	69	18	3	1	49

TABLE 3.—RESULTS OF TREATMENT

	TOTAL TREATED	DEATHS FROM HEMOR-RHAGE	MEDIAS-TINITIS	OPERATIVE SHOCK	RECUR-RENCE	INOPER-ABLE	LIVING 1 YEAR
Surgical	18	3	2	3	1 (3 mo.)	7	2

	TOTAL TREATED	PALLIATIVE	ATTEMPTED CURE	SURVIVAL PERIOD MONTHS 1-3	3-6	6-9	9-12	12-18
X-Ray	24	11	13	2	2	3	3	3

TABLE 4.—DISTRIBUTION BY RACE AND SEX IN 145 CASES OF CARCINOMA OF THE ESOPHAGUS

RACE	SEX	UPPER THIRD	MIDDLE THIRD	LOWER THIRD	TOTAL
White	Male	13	20	22	55
White	Female	3	6	4	13
Colored	Male	2	34	22	58
Colored	Female	2	8	9	19
		20	68	57	145
White & Colored	Male	15	54	44	113
White & Colored	Female	5	14	13	32
White	Male & Female	16	26	26	68
Colored	Male & Female	4	42	31	77

DISTRIBUTION BY AGE

					MEAN
White	Male	45 - 77 Avg.=61	45 - 84 Avg.=61	44 - 77 Avg.=61	61
White	Female	50 - 63 Avg.=57	33 - 74 Avg.=55	49 - 71 Avg.=58	56
Colored	Male	40 - 57 Avg.=48	30 - 73 Avg.=56	37 - 76 Avg.=57	53
Colored	Female	42 - 43 Avg.=42+	42 - 71 Avg.=58	41 - 69 Avg.=54	51
		52	57	57	55

TABLE 5.

DURATION OF DYSPHAGIA PRIOR TO ADMISSION

SITE	WHITE MALE	WHITE FEMALE	COLORED MALE	COLORED FEMALE	AVERAGE
Upper Third	6 Months	2 Months	5 Months	6.5 Months	4.9 Months
Middle Third	4 Months	5 Months	4.5 Months	3.2 Months	4.2 Months
Lower Third	5.5 Months	4 Months	5.5 Months	7 Months	5.5 Months

CLASSIFICATION AND GRADING OF LESIONS

	UPPER THIRD SQUAMOUS CELL					MIDDLE THIRD SQUAMOUS CELL					LOWER THIRD SQUAMOUS CELL					
	UNC	II	III	IV	ADENO	UNC	II	III	IV	ADENO	UNC	II	III	IV	ADENO	TOTAL
White Male	5	1	4	0	0	9	1	3	1	1	9	2	0	1	7	44
White Female	2	0	0	0	0	2	3	1	0	1	1	0	0	1	2	13
Colored Male	1	0	0	0	0	16	6	6	2	0	11	0	0	3	5	50
Colored Female	2	0	0	0	0	6	2	0	0	0	2	1	2	1	1	17
TOTAL	10	1	4	0	0	33	12	10	3	2	23	3	2	6	15	124

FREQUENCY AND SITES OF METASTASES FOUND BY CLINICAL EXAMINATION, X-RAY AND SURGERY

SITE OF PRIMARY LESION	SITES OF METASTASES															
	LYMPH NODES															
	CERVICAL	HILAR	AORTIC	MEDIASTINAL	GASTRIC	SPLENIC	TRACHEA	LUNGS	LIVER	STOMACH	PANCREAS	PERITONEUM	11TH & 12TH THOR. VERTEBRAE	4TH LUMBAR VERTEBRA	GEN. SUB-Q TISSUES	RIBS
UPPER THIRD	5	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0
MIDDLE THIRD	2	1	0	9	0	0	1	5	1	0	0	0	1	0	1	1
LOWER THIRD	0	0	4	2	14	1	0	2	2	13	1	15	0	0	0	0
TOTAL	7	1	4	11	14	1	1	8	4	13	1	15	1	1	1	1

TABLE 6.

FREQUENCY AND SITES OF METASTASES IN 44 AUTOPSIED CASES

SITE OF PRIMARY	AUTOPSIES	CASES WITH METASTASES		SITES OF METASTASES																						
				LYMPH NODES																						
		NO.	%	CERVICAL	SUPRA-CLAVIC	HILAR	MEDIASTINAL	AORTIC	GASTRIC	PERITONEAL	BRAIN	TRACHEA	LUNGS	PLEURA	LOWER THIRD	STOMACH	LIVER	SPLEEN	KIDNEY	ADRENAL	PANCREAS	PERITONEUM	THOR. VERTEBRA			
UPPER THIRD	6	4	66.6	0	0	2	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0			
MIDDLE THIRD	22	15	68.2	2	6	2	7	2	2	1	2	1	7	0	0	1	2	0	4	3	0	0	1			
LOWER THIRD	16	11	68.7	0	1	1	2	2	5	0	0	0	5	1	-	5	7	2	1	1	0	2	0			
TOTAL	44	30	68.2	2	7	5	9	4	8	1	2	1	12	1	1	7	10	2	5	4	0	2	1			

TABLE 7.

TABLE 8.—DIRECT COMPLICATIONS OF LESION

COMPLICATION	UPPER THIRD	MIDDLE THIRD	LOWER THIRD	TOTAL
Extension to Aorta	0	7	3	10
Extension to Vena Cava Inf.	0	1	0	1
Extension to Pericardium	0	1	0	1
Rupture of Aorta	0	3	1	4
Invasion of Right Lung	0	0	4	4
Lung Abscess	0	0	1	1
Broncho-Esophageal Fistula	0	10	2	12
Tracheo-Esophageal Fistula	4	0	0	4
Extension Into Trachea	1	0	0	1
Extension Into Larynx	2	0	0	2
Paralysis of Vocal Cord	0	2	0	2
Perforation of Esophagus	1	5	3	9
Liver Abscess	2	0	0	2
TOTAL	10	29	14	53

TABLE 9.—PRIMARY CAUSE OF DEATH.

	UPPER THIRD	MIDDLE THIRD	LOWER THIRD	TOTAL
Cachexia & Inanition	2	18	17	37
Lung Abscess	1	3	3	7
Pneumonia	1	0	2	3
Mediastinitis	0	7	3	10
Hemorrhage, Primary Lesion	0	4[1]	2	6
Hemorrhage, Post Operative	2[2]	1	1	4
Liver Abscess	1	0	0	1
Liver Failure	0	1	0	1
Renal Failure	0	1	0	1
TOTAL	7	35	28	70

[1] 3 Aortic, 1 Pulmonary
[2] Gastrostomies

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LXXXIX

THE ROLE OF BRONCHOSCOPY IN BRONCHIAL OBSTRUCTION

WITH SPECIAL REFERENCE TO SPASMODIC BRONCHIAL NARROWING

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Partial reduction in the size of the lumen of the trachea or partial or complete obstruction of one or more bronchi constitutes the most frequent indication for direct inspection of the tracheobronchial tree.

Stridor or wheezing is the chief symptom produced by partial narrowing of any portion of the respiratory tract, and diminished breath sounds are the most frequent physical sign. When a partially obstructed bronchus becomes completely occluded, wheezing disappears, and this may create the impression of clinical improvement.

Inflammatory or neoplastic lesions or foreign bodies in the larynx or the upper portion of the trachea can be visualized by indirect or direct laryngoscopy, but those situated lower in the respiratory tract require bronchoscopic examination for diagnosis and treatment.

Foreign bodies that enter the tracheobronchial tree provide the classical signs and symptoms of partial or complete tracheal or bronchial obstruction. Signs and symptoms vary according to the size, shape, and location of the foreign body, as well as to the length of time the object has remained in the air passages and the degree of associated bronchial or parenchymal pulmonary infection.

Wheezing is always a prominent symptom when a foreign body has been aspirated into the air passages unless there is complete bronchial occlusion. Suppression of breath sounds over the portion of the lung that communicates with the obstructed bronchus is almost always noted. A foreign body, particularly one of vegetable origin, that has been aspirated and then spontaneously expelled may cause enough residual infection to produce signs and symptoms that indicate the continued presence of the foreign body in a bronchus.

The development of oral endoscopy for the removal of foreign bodies has now widened the field of usefulness for direct inspection of the tracheobronchial tree, so that detection and treatment of lesions other than foreign bodies constitute the greater portion of such procedures.

Benign and malignant tumors narrow the lumen of the air passages and cause wheezing as an early and frequent symptom. Direct inspection of the respiratory tract is usually indicated whenever the presence of a tumor is suspected. Too frequently diagnosis of tumor is delayed because wheezing that results from narrowing of the trachea or a bronchus is thought to be due to asthma. Associated cough is usually attributed to smoking.

Tuberculous infection of the trachea, bronchi, or mediastinal lymphatic nodes may produce partial or complete bronchial obstruction, and bronchoscopic study is indicated whenever stridor occurs in the tuberculous patient, particularly before thoracoplastic compression of the lung is undertaken. Even when compression of the lung by pneumothorax is employed, preoperative inspection of the tracheobronchial tree is advisable. Partial occlusion of a bronchus from a tuberculous lesion is considered a contraindication to collapse therapy by most phthisiologists.

Other inflammatory lesions in the tracheobronchial tree, such as actinomycosis, blastomycosis, and extrabronchial inflammatory diseases, may reduce the size of the lumen of a bronchus and require bronchoscopy for diagnosis.

Although the exact mechanism of the production of atelectasis of the lung after operation or injury is not fully understood, there is always evidence of bronchial obstruction, and bronchoscopic investigation is sometimes required for diagnosis and treatment. Failure to wash out the stomach prior to emergency operations or childbirth under general anesthesia may result in postoperative vomiting and inhalation of gastric content into the air passages. Severe and sometimes fatal reactions may occur unless the bronchi are thoroughly aspirated through a bronchoscope.

If excessive sedation is given to patients with pulmonary hemorrhage so that the cough reflex is diminished or abolished, blood may accumulate in the tracheobronchial tree and simulate tumor or other lesions that cause bronchial obstruction. In such cases, bronchoscopic examination may be required to remove clotted blood from the bronchi and to aid in determining the cause of bleeding.

Spasmodic narrowing of the tracheobronchial tree usually occurs intermittently and involves all portions of the lungs. Wheezing, dyspnea, and anxiety are predominating symptoms and the condition may be termed asthma. If symptoms are continuously present with varying severity and are associated with cough and the production of mucus or gelatinous secretion, the term chronic asthmatic bronchitis may be more appropriate. Spasmodic attacks of bronchial narrowing usually result from substances that are ingested, inhaled, or injected into the body. When a specific causative factor is determined and eliminated, attacks of bronchial spasm do not recur.

The majority of patients who are considered to have spasmodic bronchial narrowing actually suffer from chronic asthmatic bronchitis. These patients may have acute attacks of bronchial spasm in addition to symptoms of chronic bronchial irritation that are present continuously in varying degrees of severity.

Removal of substances believed to be responsible for the attacks rarely relieves symptoms, and the patients resort to many types of treatment with indifferent results. Many factors probably contribute to this type of bronchial disorder, but infection, irritation in inclement weather, and especially emotional stress predominate as causative agents.

Emphysema, pulmonary fibrosis, and softening of the cartilaginous rings of the trachea and bronchi intensify symptoms after years of chronic bronchial infection and associated respiratory effort and increase the problem of diagnosis and treatment. In chronic asthmatic bronchitis, signs of localized bronchial occlusion occur and may suggest the presence of a tumor or a foreign body.

Prolonged continuous respiratory obstruction resulting from emphysema and increased flaccidity of the trachea may produce signs and symptoms that are identical to those caused by a tumor of the trachea. When patients suffering from the advanced stage of this condition are examined bronchoscopically, the lumen of the bronchi and even the lumen of the trachea may be almost obliterated by cough or respiratory effort. This anatomic interference with normal drainage of the tracheobronchial tree causes stagnation of secretion with resultant infection. The presence of infection increases cough and pulmonary fibrosis and thus a vicious cycle is established.

Unfortunately, the presence of a tumor as a cause of partial bronchial or tracheal obstruction is not suspected so frequently as spasmodic bronchial narrowing, and the diagnosis of asthma or "cig-

arette cough" has delayed recognition of bronchial carcinoma in many cases.

Bronchoscopic inspection is rarely indicated in patients who have sudden severe attacks of bronchial spasm and whose symptoms are completely relieved by hypodermic injection of epinephrine. When the attacks are definitely related to sensitivity to any substance and removal of the offending substance abolishes the seizures of bronchospasm, there is no reason for inspection of the air passages. However, the majority of patients who suffer from prolonged continuous respiratory difficulty associated with wheezing should have bronchoscopic study to ascertain the cause of narrowing of the air passages. All patients who have chronic asthmatic bronchitis with purulent sputum, fever, or expectoration of blood require bronchoscopic examination for diagnosis.

Partial occlusion of the posterior or apical division of the bronchus to the lower lobe of a lung is frequently observed in patients who have chronic bronchial spasm, and this narrowing may cause retention of secretion with resultant infection and fever. Dilation of the narrowed bronchus promotes drainage and usually affords prompt relief. Even when pus is distributed diffusely throughout both lungs, aspiration of secretion and insufflation of sulfonamides or penicillin may produce favorable results.

Patients having so-called status asthmaticus are rarely benefited by bronchoscopic treatment, and the examination is associated with considerable risk in those who are exhausted from prolonged respiratory effort. Sufferers from bronchial spasm may be sensitive to a variety of drugs, and the use of any anesthetic agent or any product administered to prevent reactions to anesthetic preparations may cause alarming symptoms or fatal results. I do not believe that any precautions suggested previously can prevent occasional deaths from local anesthetic agents, especially of patients who are susceptible to bronchial spasm.

Although emotional factors are responsible for the development of bronchial spasm in many individuals, bronchoscopic investigation should not be recommended as a psychotherapeutic procedure. Relief from spasmodic bronchial narrowing has followed bronchoscopic examination and benefits apparently have resulted because of psychogenic factors, but unless there are other indications, oral endoscopic inspection of the tracheobronchial tree is inadvisable in patients whose difficulty is on an emotional basis.

SUMMARY

1. Partial or complete obstruction of portions of the tracheobronchial tree occurs frequently and may be caused by a wide variety of lesions.

2. Stridor or wheezing is the most frequent and significant symptom of partial bronchial obstruction.

3. Spasmodic bronchial narrowing produces symptoms which may be confused with those caused by organic lesions. Indications for bronchoscopic examination in differential diagnosis and treatment are suggested.

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XC

BRONCHOLITHIASIS

REPORT OF SIX CASES

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That true broncholithiasis is not often encountered is shown by the fact that Lloyd[1] could find only 18 reported cases in the English literature between 1900 and 1930. At that time he reported four new cases. Subsequently Maytum and Vinson[2] reported a case simulating bronchial carcinoma.

In 1935 Pendergrass and de Lorimer[3] reported two cases. Moersch[4] added another case in 1937 and Schmidt[5] described his case in 1938. Myers[6] reported his case in 1940. Van Orstrand, Moore and Harris[7] reported two cases in 1942. In 1944 Anderson and Mackay[8] reported a case in which lobectomy was performed for a suspected adenoma of the middle lobe, but postoperatively several broncholiths obstructing the bronchi were found. In 1944 Tinney and Moersch[9] reviewed the files of the Mayo Clinic and they were able to uncover 28 cases of broncholithiasis from their records. Fox and Clerf[10] reported ten cases in 1945. This makes a total of 69 cases, to which six are added.

That the number of cases reported does not represent the true incidence of broncholithiasis is an accepted fact. Undoubtedly other proven cases may have been encountered which as yet have not been reported in the literature. Likewise, many cases of broncholithiasis in the past have been mistaken for other types of pulmonary disease. This was particularly true before bronchoscopy was frequently used as an aid in the differential diagnosis of pulmonary disease. Even with the aid of bronchoscopy the actual diagnosis of broncholithiasis may be difficult in those cases where the broncholiths are located in the smaller bronchi and produce segmental obstruction of a lobe, thereby simulating infection, tuberculosis or new growth.

The latter was true in the case reported by Anderson and Mackay, and in an almost identical case reported by the author.

It is an accepted fact among investigators who have had experience with this entity that broncholiths may originate within the

lumen of the bronchus as a result of aspirated foreign bodies, retention of secretions and long-standing inflammatory processes, such as lung abscess, unresolved pneumonia and bronchiectasis. In the majority of cases these calculi develop extrabronchially by calcification of the lymph nodes as a sequela of an infection in these nodes, most commonly of a tuberculous nature.

Because of the proximity of these calcified nodes to the respiratory tract they may gradually erode through the bronchial wall and may partially or completely occlude the lumen of the bronchus, thus behaving typically as a foreign body, and may produce bizarre pulmonary changes unless they are expectorated. The persistence of the broncholith in the tracheobronchial tree may produce paroxysmal coughing, which may be associated with an asthmatoid wheeze, a condition which has been aptly described "stone asthma." Because of the attacks of paroxysmal coughing patients experience dyspnea of varying degrees and may sometimes present the picture of intractable asthma. Hemoptysis may occur long before the calculus is expectorated and may be very severe; in this respect broncholithiasis may simulate bronchiectasis or bronchogenic carcinoma.

The actual diagnosis may be entirely missed in these cases unless the patient gives definite history of having coughed up some calcareous material, in which event one's suspicion should be immediately aroused. The history of cough of a paroxysmal type associated with severe chest pain should likewise arouse suspicion.

The original x-ray examination may be entirely unhelpful because of the many types of pulmonary pathology that a broncholith may give rise to, according to its location. The bronchoscopic examination may solve the problem if the broncholith happens to be located in one of the larger bronchi which is visible to direct inspection. However, in those cases where the stone is located in a smaller subdivision of the main bronchus the bronchoscopic examination itself would not offer any definite clue to the actual trouble. In these patients films made with a Bucky diaphragm may give a clue that a broncholith is present. However, I believe that planigraphic studies are of extreme importance and will show the presence of these stones if proper exposures are made. Not only are they helpful in identifying the presence of a stone, but they also will give added information as to location, size and contour of the broncholith itself.

The treatment depends upon establishment of the presence of a broncholith and its location. If it is found in one of the larger bronchi which is directly accessible to bronchoscopic visualization,

it may be readily grasped and removed either in toto or in fragments, even though it may require several attempts.

In those cases in which the broncholith is located beyond the point of visualization, it may be extremely difficult and rather unwise to remove the stone by this process, because if a segment of a bronchus has been obstructed for any length of time there is always a pathologic condition in the involved portion of the lung; in these cases thoracic surgery would be the safest procedure.

In those patients who have expectorated broncholith spontaneously further investigation by direct inspection of the tracheobronchial tree is definitely indicated to eliminate the possibility of more of these bodies being present and also for therapeutic aspiration to clear up any associated infection which may be present. In some of these cases several bronchoscopic examinations may be necessary in order to clear up the infection completely.

REPORT OF CASES

CASE 1.—G. S., a 42-year-old white female, was admitted to the Abington Hospital October 31, 1937, with history of having had a previous admission at another hospital because of paroxysmal coughing, hemoptysis and loss of weight. A bronchoscopic examination had been attempted but the bleeding was so profuse at the time that it had to be discontinued. In view of the patient's history and symptoms and the findings at bronchoscopic examination a tentative diagnosis of carcinoma of the left lung was made. The patient left this hospital and returned home where she was treated for several weeks and then was admitted to the Abington Hospital because of severe attacks of hemoptysis associated with her cough.

The x-ray examination on admission revealed almost complete opacity of the entire left chest with moderate shift of the mediastinum to the left and good aeration of the right lung.

A bronchoscopic examination was made shortly after her admission to the hospital, at which time it was found that the left main bronchus was full of ulcerating tissue, completely obstructing the lumen. The bleeding was quite free but was controlled sufficiently with saturated solution of tannic and gallic acid applied on applicators to the surface. A biopsy specimen was obtained and the impression, in view of the findings at this examination, was bronchogenic carcinoma. The histological examination of the tissue, however, revealed no evidence of cancer but the presence of granulation tissue.

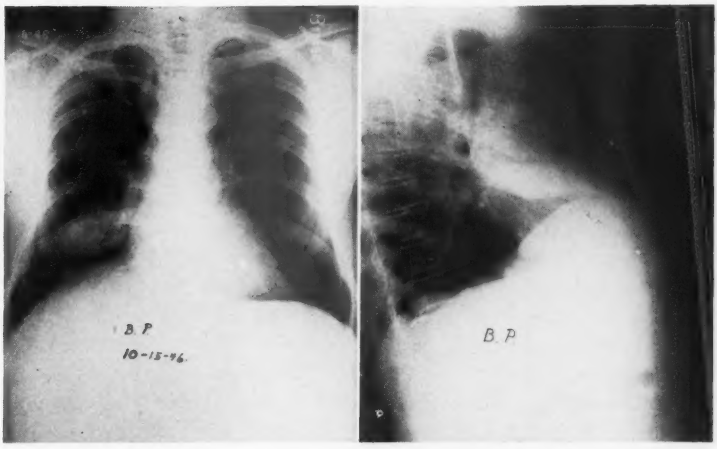

Fig. 1, Case 2.—Roentgenograms showing atelectasis of middle lobe.

Another bronchoscopic examination was made and at this time, in the process of getting another specimen, there was a grating sensation on the blades of the forceps and immediately the suspicion of foreign body was aroused. A forward-grasping forceps was then used and a firm substance was removed and found to be an irregular, spherical calcified object about the size of a pea. The examination of this substance revealed it to be composed of calcareous material.

Several bronchoscopic examinations were made subsequently to clear up the associated infection in the left lung. The x-ray examination of the chest after the removal of the broncholith showed re-expansion of the entire left lung with normal aeration. Bronchograms of the left lung did not reveal any evidence of bronchiectasis.

This patient is well today and has had no recurrence of symptoms.

CASE 2.—B. P., a 50-year-old white male, was first admitted to the Pennsylvania Hospital on September 11, 1946, because of cough, hemoptysis and night sweats. X-ray examination of his chest revealed an area of atelectasis occupying the greater portion of the right middle lobe, with the trachea pulled slightly toward this side (Fig. 1).

The patient was referred to the Bronchoscopic Service and the bronchoscopic examination on September 16, 1946, revealed the mucous membrane of the trachea to be moderately inflamed. The bifurcation did not show any gross abnormality. Examination of the right main bronchus revealed the middle lobe orifice to be very definitely reduced in size and the mucous membrane very hemorrhagic. No secretion could be found coming from the middle lobe orifice on attempt at aspiration of material from the middle lobe proper. The right lower lobe subdivisions revealed less inflammatory changes and only a small amount of secretion could be seen coming from the openings themselves. This material was submitted to the laboratory for bacteriological study including tuberculosis smear and culture. An attempt was made to obtain a biopsy specimen by passing a ball forceps into the lumen of the right main bronchus to get some tissue from beyond the point of visualization, and several small pieces were scraped from the surface and submitted to the laboratory for histological examination. These revealed no evidence of malignancy. The study of the secretion showed no tubercle bacilli on the concentrated smear. The patient showed some improvement and was discharged from the hospital to be followed as an outpatient.

Shortly after he left the hospital, however, he began to have severe coughing attacks with hemoptysis and was readmitted. The chest was again x-rayed and at this time it was found that the lesion in the middle lobe had increased in size. Another bronchoscopic examination was made and the predominant finding was again very marked inflammatory changes localized in the middle lobe opening, with the presence of some blood-tinged material coming from it. This material was submitted to the laboratory for tumor cell study and reported negative. Repeated bronchoscopic examinations revealed practically the same findings.

Because of the increase in the size of the lesion as visualized by x-ray examination, the patient was seen by Dr. John B. Flick in consultation and exploratory thoracotomy carried out, at which time the findings were so suspicious of carcinoma that a total pneumonectomy was performed on October 29, 1946. However, careful examination of the removed lung revealed the presence of broncholiths in the subdivisions of the middle lobe bronchus. There was severe damage to the entire middle lobe.

This case almost parallels the one reported by Anderson and Mackay, and again reveals the protean manifestation of this entity in its ability to simulate other types of pulmonary disease.

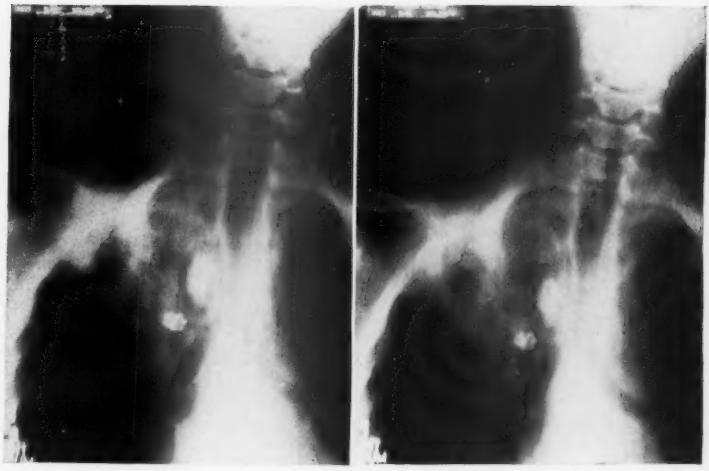

Fig. 2, Case 3.—Planigraphic films showing broncholith in right upper lobe bronchus.

CASE 3.—J. W., a 40-year-old white male, had five admissions to the Abington Hospital between November 1945 and December 1946. On each occasion the patient was admitted because of high fever, persistent cough and extreme weakness. The diagnoses made on various admissions ranged from virus pneumonia, psittacosis, tuberculosis and lung abscess. He responded fairly well to penicillin therapy on each admission and when he showed sufficient improvement he was discharged from the hospital, only to have a recurrence of the same symptoms.

On his admission of November 14, 1946, I was asked to see him in consultation for bronchoscopic examination. The x-ray examination of the chest at this time revealed the presence of three large calcified nodes in the right upper lobe, with definite increased density of the lung tissue throughout the entire upper lobe area. This patient had recently experienced several attacks of severe hemoptysis.

At bronchoscopic examination it was noted that there was considerable thickening of the mucous membrane at the level of the bifurcation, which on further examination appeared to be localized around the right upper lobe orifice which was completely occluded by granulation tissue. Beyond this point the lumen of the right

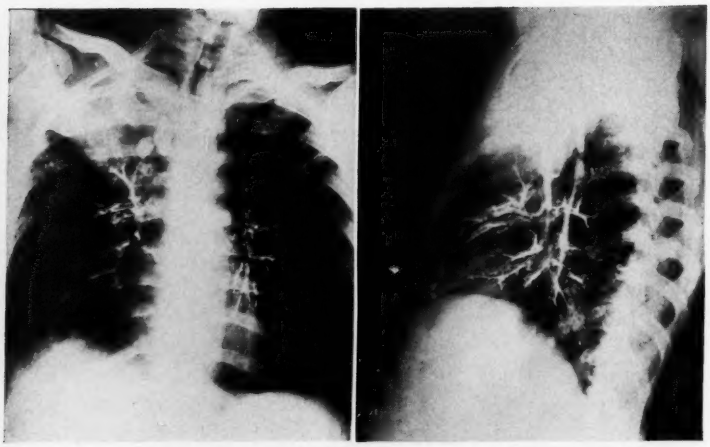

Fig. 3, Case 3.—Bronchograms of right lung made to eliminate the presence of disease in the right middle and lower lobes.

main bronchus appeared normal and showed only a small amount of secretion coming from the right lower lobe. A specimen of granulation tissue was obtained and sent to the laboratory for tuberculosis study and also for histological examination for cancer. The bloody secretion which was aspirated was examined for tubercle bacilli by smear and culture. Because of the frank bleeding encountered it was impossible to get a good visualization of the upper lobe opening by retrograde telescopic examination.

The secretion was reported to be negative for tubercle bacilli and the tissue was found to be inflammatory in nature, rather than malignant.

Another bronchoscopic examination was made and at this time a No. 9 bronchoscope was used. The right upper lobe orifice was clearly brought into view and I was able to visualize a sharp projecting object within the orifice. It could be readily grasped by a side-curved and forward-grasping forceps, but could not be removed with the average traction. On one of these attempts a portion of this object broke off and on examination it was found to be calcareous. We became suspicious that we were dealing here with a definite broncholith in the right upper lobe rather than an aspirated foreign body.

Planigraphic studies were subsequently made (Fig. 2), which clearly substantiated our suspicion. The broncholith was partially within the lumen of the right upper lobe bronchus and partially outside of the wall.

Because of the extreme damage present in the right upper lobe of the lung and the firmness with which the broncholith was imbedded, it was thought foolish to attempt bronchoscopic removal, for it would certainly be endangering the patient's life. To eliminate the presence of any disease in the middle and lower lobes bronchograms were made and these showed a normal distribution of the bronchial tree in these areas (Fig. 3). The iodized oil did not go into the upper lobe itself.

It was felt advisable to obtain surgical consultation and Dr. John B. Flick saw the patient and performed a lobectomy on January 30, 1947, with complete removal of the right upper lobe with the broncholith.

The following are brief reports of three other cases.

CASE 4.—M. S., a 72-year-old white male, was admitted to the Pennsylvania Hospital on December 21, 1942, because of persistent cough, pain in the chest and hemoptysis. He also gave the history that several days prior to admission he had coughed up a hard, gritty piece of material and hemoptysis began immediately after this episode. X-ray examination of his chest on December 18, 1942, was reported as follows:

"In both apices there are a few very small areas of infiltration and there is some thickening of the pleural cap on the right side. All of these changes look like an old, healed, minimal tuberculous infection and there is nothing in their appearance to suggest that they might be responsible for any of the recent symptoms. Elsewhere the lung parenchyma is clear. The right hilum is somewhat enlarged, as are the trunk shadows toward both bases. This is not sufficient to suggest a bronchiectasis from films without a contrast media. The enlarged hilum, of course, brings up, in association with hemoptysis, the possibility of a new growth. The findings are not characteristic."

On admission a bronchoscopic examination was made and a very peculiar finding was present. Right at the orifice of the right main bronchus on the medial wall, just below the bifurcation, there was an eroded area of mucous membrane with a small piece of calcified material sticking out from it. This was removed without difficulty and on inspection was found to be firm and calcareous. The bleed-

ing appeared to be coming from this localized area of eroded mucous membrane.

In view of the patient's having coughed up the same type of material we felt that this was a case of a broncholith eroding through the medial wall of the right main bronchus just below the bifurcation. Following the removal of the broncholith this patient has had no recurrence of hemoptysis and is living and well today.

CASE 5.—H. S., a 31-year-old white female, was admitted to Hamburg State Sanitorium with the history of hemoptysis and suspicion of tuberculous infection. X-ray examination revealed partial atelectasis of the left lower lobe, with increased density of the lower portion of the upper lobe. Sputum examinations had been repeatedly negative for tubercle bacilli. To eliminate definitely the possibility of a bronchial type of tuberculosis a bronchoscopic examination was made and the left main bronchus was found to be completely occluded by granulation tissue. On attempt at removal of this tissue firm calcified material was encountered, and when grasped by forward-grasping forceps a large amount of broken up pieces of this calcified substance was removed. The tissue was sent to the laboratory for histological examination for tuberculosis and carcinoma and found negative for both. Further examination of the calcareous material revealed it to be definitely a broncholith which apparently was filling the lumen of the left main bronchus just below the left upper lobe orifice. Following the removal of these foreign bodies the bronchus remained patent and the granulation tissue disappeared. Bronchographic studies were subsequently made, which revealed extensive bronchiectatic dilatation in the entire left lower lobe. The lingular portion of the left upper lobe was not involved.

This case shows the residual damage that may result from a long sojourn of a broncholith in the lumen of the main bronchus when it produces total obstruction.

CASE 6.—This case is of unusual interest because of the circumstances involved. J. E., an ex-Major in the United States Marine Corps Reserves, who had previously been a patient of mine, consulted me because of a recent illness, which had occurred while he was still in the service. He gave the history that in February 1944 he suddenly developed a severe wracking cough which was complicated with expectoration of free blood. During one of these episodes of coughing the patient put his hands to his mouth to refrain the gush of blood which he felt in his throat, and noticed a foreign body

hit the palm of his hand with forceful impact. On inspection he noted that there were several pieces of calcified material in the palm of his hand. Because of repetition of this episode he was immediately hospitalized at Bethesda Naval Hospital where he was completely studied from March 5, 1944, to May 1, 1944. Bronchoscopic examinations made at this time further substantiated the diagnosis of broncholithiasis.

The prognosis of broncholithiasis is dependent largely on the location and size of the broncholith and the duration of the symptoms. In the patients who have had long-standing obstruction there is invariably considerable damage to the involved portion of the lung, with abscess formation or extensive bronchiectasis. The latter was true in Case 5, as proven by subsequent bronchograms. Needless to say in these cases the removal of the broncholith does not clear the complications, so that each patient presents his individual problem.

CONCLUSIONS

1. Broncholithiasis may produce changes which may simulate any form of pulmonary pathology.

2. The history of hemoptysis associated with severe wracking cough and pain and the expectoration of small calcareous particles should lead one immediately to suspect the possibility of broncholithiasis.

3. The diagnosis may be entirely missed if one relies just on the routine film of the chest. Films made with a Bucky diaphragm may be more helpful, but the planigraphic studies have proven of extreme value not only in revealing the broncholith but also in localizing its position in relation to the bronchus. These latter studies also give in much better detail the degree of damage which may have resulted in the surrounding lung tissue.

4. Bronchoscopic examination should be made a routine procedure in the investigation of suspected pulmonary disease. In this way many of these cases may be discovered early, before extensive pathologic changes of the lung have occurred. Bronchoscopy may also be extremely helpful in the removal of these broncholiths when they are located in the larger bronchi where they are accessible. However, in cases where these objects are not readily accessible to bronchoscopic removal it would be better to resort to surgical removal,

particularly so since there is always considerable damage to the surrounding lung tissue, and just the removal of the broncholith would not be sufficient to eradicate the residual disease.

Case 2 is reported through the courtesy of Dr. Garfield G. Duncan, Director of Medical Services, and Dr. John B. Flick, Director of Surgical Services at the Pennsylvania Hospital.

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Society Proceedings

SIXTY-EIGHTH ANNUAL MEETING

OF THE

AMERICAN LARYNGOLOGICAL ASSOCIATION

St. Louis, Mo., April 23-24, 1947

DR. H. MARSHALL TAYLOR, VICE-PRESIDENT, PRESIDING

(Abstracts of Proceedings)

The Pathology of Nasal Polyps

J. J. SHEA, M.D.

MEMPHIS, TENN.

(This paper appears in full on page 1029.)

DISCUSSION

DR. HARRY P. SCHENCK: Billroth in 1855 made a classification of nasal polyps which has not been greatly improved upon to this day. His recognition of mucous polyps as a distinct entity was later supported by Zuckerkandl and Wacht. The latter also showed that all polyps, including carcinomatous, fibrous and adenomatous, had a common origin in the mucous membrane and possessed all the components of the membrane in abnormal relationship. Mucous polyps are the most common type found in the nose and, although their relationship to allergy is difficult to prove, the evidence is very convincing. Zuckerkandl pointed out eight sites of origin of polyps which agree with the ridges described by Van Alyea and which are frequently overlooked. They are in relationship to the turbinate, which is the shock organ of the nose responding to allergic irritation. Involvement of adjacent ethmoid cells in the polypoid degeneration

is the result of the spreading vascular reaction originating in these tissues. It is important that all polyps or polypoid tissue removed from the nose be subjected to histologic study for the determination of their pathogenesis.

Dr. Burt R. Shurly: It is important to study the individual in every case of polyposis. We frequently are prone to exaggerate and attribute all polyps to allergy. These tumors should be removed in order to afford the patient improved breathing space and to study the underlying pathology.

Dr. Robert F. Ridpath: Compared to the great number of people suffering from allergy, very few develop polyps. Other etiologic factors must be investigated. Experiments of a biochemical nature have shown that in many of these cases there is a deficiency in calcium and a persistent leukocytosis. This suggests a deeper pathogenesis necessitating much further study.

Dr. Samuel Salinger: Much confusion arises from the fact that we have included under the term "nasal polyp" a variety of growths having different pathogeneses and pathologic characteristics. The fault is rather in our nomenclature and in the loose application of the word. The average physician considers a nasal polyp to be a pedunculated mass or group of masses which he believes are due to an allergic background. Tumors removed from the nose should be designated as benign or malignant until pathologic examination reveals their true characteristics by which they may be recognized and properly named.

Dr. John J. Shea (in closing): Bacteriologic studies have been carried out during the past year in the hope of uncovering something significant. The data, thus far, have proven inconsistent. It is hoped that further study along this line may be more productive.

Unusual Sinuses of Interest to the Surgeon

F. W. Dixon, M.D.

Cleveland, Ohio

A colored motion picture is shown depicting the sinuses in various sections of the skull. Attention is directed to the wide variations in development and extension of the frontals, ethmoids

and sphenoids. Encroachment of these cavities on the terrain of the others is so common that the term "normal" can but seldom be employed, except possibly in the case of the antrums which are more frequently symmetrical than the others. Careful study of the conformation and extent of the sinuses is extremely important not only in the analysis of symptoms but in surgical procedures, where this information is paramount.

DISCUSSION

DR. B. N. COLVER: Two cases of unusual sinus conformation are germane to the subject. In the first, asthma was relieved by removal of a single polyp and splitting a large cystic turbinal bone, the lateral half of which contained two small polyps which had not yet developed. There were no other cells or polypi. In the second case a draining fistula in the upper lid, due to an abscess following an injury two years previously appeared to be due to a frontal sinus infection as shown in the x-ray films. Operation disclosed a normal frontal sinus with an infected ethmoid lying laterally which was the seat of the original infection.

DR. OLIVER E. VAN ALYEA: Dr. J. Parsons Schaeffer some years ago made the significant statement that variability in sinus conformation was so common as to be considered normal. Two adjoining sinuses such as the frontals and sphenoids growing up together are extremely likely to override in one direction or the other, with consequent invasion of the opposite side. In addition to osteomas appearing in the vicinity of the ostium of the frontal sinus, causing obstruction to drainage, one must not lose sight of the accessory cells which trail along with the frontal sinus in its upward growth, causing distortion and blocking drainage.

DR. W. LIKELY SIMPSON: Among the abnormalities I have seen may be mentioned an infraorbital nerve entirely surrounded by bone, having no connection with the orbital floor, and an optic nerve entirely within the lumen of the frontal sinus and having no connection with the periphery except anteriorly and posteriorly. These, and Dr. Dixon's cases, show why conservative treatment fails in many cases because of abnormal conformation interfering with drainage, conditions that are disclosed only at operation.

Tumors of the Nasopharynx

H. J. Williams, M.D.

Philadelphia, Pa.

For accurate diagnosis of tumors of the nasopharynx it is important to get a clear view with the postnasal mirror as well as to employ the nasopharyngoscope. Malignant growths of the nasopharynx are most common between the ages of 40 and 60, and comprise three per cent of all cancers of the upper respiratory tract. Squamous cell carcinoma and reticulum cell sarcoma are the most common types encountered. Anaplastic carcinoma is usually associated with early involvement of the cervical lymphatic glands and frequently this constitutes the earliest indication of the process. Early involvement of the eustachian orifice gives rise to symptoms of auditory obstruction. Increased growth may lead to involvement of the orbit, paranasal sinuses and cranial cavity with symptoms that are unmistakable. Many of these growths are radiosensitive and will regress considerably under appropriate irradiation. Three cases are presented.

The Surgical Treatment of Nasopharyngeal Fibromas

J. M. Brown, M.D.

Los Angeles, Calif.

(This paper appeared in full on page 294 of the June 1947 issue.)

DISCUSSION

Dr. Perry G. Goldsmith: The great danger in these cases is hemorrhage. We had a patient die on the table as a result of the bleeding, which was not appreciated at the time because the suction apparatus was draining the blood into a bottle beneath the table. Mistakes are made and should be told as an antidote to undue enthusiasm over brilliant results. In one case of severe hemorrhage the wrong carotid was tied. The opposite artery was then ligated and still the patient bled, leaving the surgeon in a deep quandary. Fortunately, under deep x-ray therapy the remnant of the growth disappeared and the patient recovered. Radiation has a definite place in the therapy of these tumors and frequently accomplishes what

surgery alone may fail to do. These growths are all malignant, whether termed fibroma or sarcoma. The terminology all depends on the degree of cellular element in relationship to the fibrous component of the mass.

DR. F. T. HILL: The term "fibroma of the nasopharynx" may be a misnomer because, although the tumor grows from the fibrous tissue of the periosteum of the sphenoid, it is actually an extremely vascular mass. Perhaps the term "vascular fibroma" or "angiofibroma" would be more accurate. Extensive growth of the tumor may preclude the possibility of surgical extirpation, as demonstrated in a case where it invaded not only the nasopharynx, but the ethmoids, the orbit and the floor of the anterior fossa, causing a spontaneous pneumatocele. Under treatment with radon implants, plus surgical diathermy, an excellent result was obtained.

DR. JOHN H. FOSTER: Experience over a period of years has demonstrated the advantages of radon implantation in these cases, so that surgery was rarely found necessary. Certainly the regression takes place without danger of hemorrhage and when surgery is necessary to remove the residual mass the influence of the radiation is manifest in the slight bleeding that attends this delayed procedure. It may take several applications of the radium over a period of time to accomplish these results, but the freedom from danger of hemorrhage makes it worth while.

DR. FREDERICK A. FIGI: Surgical removal of juvenile nasofibromas is an extremely formidable procedure. Dr. Brown's excellent results in his series are noteworthy. Many growths are so extensive as to be beyond the reach of surgery. While radiation therapy yields satisfactory results to a certain degree, one must remember that the therapy is often followed by unpleasant sequelae, such as atrophy of the mucosa with crusting. Our results have been more satisfactory when we used surgical diathermy in conjunction with radiation. A recent case exemplifies some of the difficulties. A young man of 18 had a tumor which filled the nasopharynx, the right nasal fossa, the antrum, ethmoid cells and retromaxillary fossa. The right cheek bulged markedly. Consequently the tumor was approached through the antrum and destroyed as far as possible with surgical diathermy following ligation of the external carotid. Radon seeds were then implanted into the residual mass and, despite the drainage of Stensen's duct into the operated antrum, which gave rise to a suspicion that the discharge was cerebrospinal fluid, the entire condition cleared up after closing the defect in the anterior wall which had communicated with the mouth.

DR. BROWN (in closing): I have no quarrel with those who wish to use radium. This therapy takes considerable time and, as has been stated frequently, is followed by atrophic changes. It probably is a safer therapy in the very young when the tumor is more vascular. However, in older individuals, when the tumor tends to regression, the surgical approach described has a definite place in our practice.

A Study of the Eustachian Tubes: Their Orifices and Lumens

W. L. SIMPSON, M.D.

MEMPHIS, TENN.

(This paper appeared in full on page 357 of the June 1947 issue.)

DISCUSSION

DR. FRANCIS L. LEDERER: To evaluate function properly, it should be observed under normal physiologic conditions. This does obtain under the conditions represented in the cases shown. Is it not possible that the absence of change in the permeability of the eustachian tube during the muscular contractions observed may have been due to the absence of the normal hermetically sealed cavity?

DR. B. N. COLVER: With altered anatomy one may reasonably expect altered physiology. In this instance it is my feeling that the opening or closure of the tube takes place at the isthmus rather than at the orifice. Whether the opening or closing is strictly the result of muscular action, or whether it is due to the pneumatic plus or minus change, is another question which should be considered.

DR. SIMPSON (in closing): Answering Dr. Lederer, I would say that these examinations were made soon after operation and confirmed repeatedly over a period of years. In the five cases cited, each patient had normal hearing and we found that the tube is not closed at any time and its patency is not affected by swallowing or what not. Answering Dr. Colver, my observations show that the tube closes from the orifice to the isthmus and its lumen is not affected by muscular action.

The Pathology and Surgery of Extrinsic Cancer of the Larynx

H. B. Orton, M.D.

Newark, N. J.

Fifty-one cases of extrinsic carcinoma of the larynx, in which surgery was resorted to, resulted in 27 per cent five-year cures. These growths involved the epiglottis, aryepiglottic folds, pre-epiglottic space, pyriform fossa and postcricoid area, and required extensive resection of pharyngeal tissues as well as bilateral removal of the regional glands. Compared to irradiation in this type of growth the surgical results are most favorable. Reports of success from irradiation therapy, so frequenty labelled as "regression," cannot be considered as cures when the five year limit is applied. Radium and x-ray should be used only when the patient refuses surgery or when the case is clearly inoperable. Many persons given irradiation therapy might have been saved had adequate surgery been employed in the first instance. The pharyngostoma resulting from this operation can be closed by a plastic procedure at the appropriate time.

DISCUSSION

Dr. Francis E. Le Jeune: This presentation should revise our thinking in the matter of extrinsic cancer of the larynx. The results Dr. Orton has shown are truly amazing. The procedure is an heroic one since most cases require complete block dissection of the neck. Jacobson stated long ago that the life expectancy without surgery in this type of case was from 12 to 15 months. Successful operation, therefore, even in a minority of the cases, is certainly to be commended.

Dr. Le Roy A. Schall: Radical dissection of the glands in these cases has revealed the fact that many of them are the seat of metastases despite absence of demonstrable palpability. We have made it a practice to remove the sternohyoid muscles with the body of the hyoid bone in order to be sure that the lymph gland in the cricoid membrane is eliminated together with the rich lymphatics in the muscle bed. Like Dr. Orton, we too are in favor of exploring the carotid sheaths. We feel that every intrinsic cancer of the larynx is a potentially extrinsic case. The greatest difficulty in all cases is the selection of a proper procedure. Irradiation, when properly applied by an expert, has a definite place in our therapy. Our records reveal 24 per cent of cures in extrinsic cases treated between 1930

and 1940. It certainly should be employed in cases where the patient refuses radical surgery or his general condition contraindicates it. Finally, it is very important that all patients be followed up with yearly examinations for at least ten years.

DR. LOUIS H. CLERF: There are unfortunately too many radiologists who think in terms of palliation, reporting results after two or three years. In our opinion, the five year limit should be considered minimal. Furthermore, where irradiation has failed it has been our experience that subsequent surgery is more difficult and the results not as good had there been no preceding radiation therapy. There is still some confusion in the terms "intrinsic" and "extrinsic." The decision between thyrotomy and laryngectomy depends not so much on whether the lesion is restricted to one cord, but on the degree of infiltration and fixation indicating extension to the cartilage itself. As for the truly extrinsic cases in which the epiglottis, its folds, the arytenoid are involved one must be radical through sufficiently adequate exposure. The object is to save the patient's life, disregarding for the moment the tissues which must be sacrificed.

DR. FREDERICK A. FIGI: We, too, favor radical surgery in the type of case described by Dr. Orton. While it is true we have seen several extensive growths apparently retarded for three to five years, we still feel that better results can be obtained through procedures such as described by Dr. Orton.

DR. EDWIN N. BROYLES: There was a time when operating on a larynx if we found the carcinoma had extended through the cricothyroid membrane, we would back out and turn the patient over to the radiologist. Today we follow the lead of the general surgeon and proceed to remove all the diseased tissue, including the glands and muscles.

DR. CHARLES J. IMPERATORI: I agree with Dr. Orton and the others regarding the necessity of radical surgery in the type of case previously considered inoperable. However, I believe we should give more thought to the problems of cancer research, since there is hope that through metabolic, biochemical or endocrine mechanisms as yet undiscovered, the way may be paved for a therapy that may in the future make surgery unnecessary. Until that day arrives we must employ every means at hand, including radical surgery and irradiation, thoroughly, courageously and skillfully, as demonstrated by Dr. Orton.

DR. HENRY B. ORTON (in closing): Answering Dr. Imperatori, I do state in a portion of the paper which, for lack of time, I

was unable to read that our objective is complete destruction of the cancer, whether by surgery, irradiation, or some as yet undiscovered biological or biochemical process. Concerning the definition of extrinsic, we consider any lesion above the vocal cord as in that category. If the growth is on the epiglottis, its folds, the arytenoid, the pyriform sinus, or the pharyngeal wall, we term it "epilaryngeal." It must be recalled also that a lesion beginning as extrinsic may also become intrinsic as well as vice versa.

Of 48 patients discussed in this presentation, 18 are alive and well after five years or more, a little over 40 per cent.

Hemangiomas of the Mouth

F. A. FIGI, M.D.

ROCHESTER, MINN.

(This paper appears in full on page 853.)

The Thyroid and the Nose

A. W. PROETZ, M.D.

ST. LOUIS, MO.

(This paper appeared in full on page 328 of the June 1947 issue.)

The Present Status of Diphtheria

E. H. PLACE, M.D.

BOSTON, MASS.

(This paper appeared in full on page 347 of the June 1947 issue.)

DISCUSSION

DR. BURT R. SHURLY: My interest in this topic is more than academic, since I happen to be the survivor of three children afflicted with this disease. I have seen all the marvelous progress in the therapy of diphtheria from the pre-antitoxin days up to the present,

and the memory of the numerous intubations, with all the trials and tribulations involved in the care of these patients, is still very vivid. There has been improvement in our results following earlier diagnosis and the employment of larger initial doses of antitoxin. Of greatest importance has been the widespread use of immunization in children. We must never relax our vigilance in this direction. I believe that intubation is still a proper procedure. A tracheotomy can always be done should the former prove inadequate.

DR. GORDON F. HARKNESS: I should like to have Dr. Place discuss those membranous inflammations in which the organisms are identified as Corynebacterium diphtheriae, Bacillus Hofmann or Bacillus erodiens. It is my understanding that as nonvirulent organisms they are not variants of the virulent organism at any time. From my meager knowledge, it appears that the only method of positive identification is through guinea pig inoculation. The possibility of legal entanglement through mistaken quarantine in a case of a nonvirulent membranous lesion must be considered. I know of one such case.

DR. PAUL HOLINGER: The incidence of diphtheria in our Children's Hospital is so low that we frequently forget it. It certainly must always be kept in mind in all children admitted for laryngeal obstruction. I should like to know what Dr. Place's experience has been relative to age incidence at the present time. We have seen one case of a 22-month-old infant admitted in a moribund condition due to an overwhelming diphtheria; also another death in a two-month-old infant.

DR. HENRY B. ORTON: The question of chronic stenosis following intubation is very important. Years ago I fell heir to quite a number of these cases. The questions I would like to ask Dr. Place are, "How often do you intubate at the Boston Hospital and, if the tube is coughed up once or twice, will you reintubate in preference to doing a tracheotomy?" We have found that we have no stenosis since we established the rule that if the patient expels the tube two or three times we will do a tracheotomy.

DR. F. T. HILL: I would like to ask Dr. Place whether or not the program of mass immunization, perhaps inadequately carried out, might tend to decrease the natural immunity of the individual.

DR. H. MARSHALL TAYLOR: The fact that we do not see diphtheria as often as previously is all the more reason we should keep our eyes open. Only recently I saw a child suffering from epistaxis

who had a paralysis of the lower extremities, yet several physicians had missed the diagnosis. I should like to ask Dr. Place whether he has seen a higher incidence of paralysis in the nasal cases than in the pharyngeal, and whether he has any suggestions as to therapy in this complication. I have seen three cases of paralysis of the lower extremities in children who seemed to get along very well on a velocipede, as did the patient first mentioned.

DR. BARNES: It is important that the otolaryngologist recognize the atypical case. We saw a case at the Naval Hospital, of a young man with infectious mononucleosis, Vincent's infection of the gums and diphtheria, all at the same time. Another case was one which ended fatally in which the organism had been diagnosed as diphtheroid. Only later did we learn that another child in the family had recently had diphtheria.

DR. PLACE (in closing): Coughing up the intubation tube has always been a problem. However, we have found fewer instances of this complication since using the Bayer tube in place of the O'Dwyer. Naturally much depends on selection of a tube of the proper size as well as on the skill of the physician.

As for toxoid versus toxin-antitoxin, we have found the former preferable for children and the latter for adults. Concerning membranous infections not truly diphtheria, we feel that there is no basis for assuming that there is a nonvirulent diphtheroid infection. Diphtheroids produce no disease. The germ is prevalent everywhere and has no pathological significance. As has been stated by some of the speakers, we cannot emphasize too strongly the importance of giving antitoxin early in adequate doses, even when the diagnosis is not definitely established. The possibility of diphtheria being present in association with other infections must also be kept constantly in mind.

Dr. Holinger spoke of age incidence. We have not noticed any perceptible change in that respect. Certainly the age of the patient is no criterion of any value. It is possible, however, that the apparent increase in cases among adults may be due to general immunization in childhood. In the case of smallpox this was more apparent.

As for stenosis due to pressure of the tube, as mentioned by Dr. Orton, we believe the factors are those previously mentioned, namely, too large a tube or unskillful manipulation. The case is different when the obstruction is due to streptococcus infection. Here the danger of perichondritis is great, and the patient is safer

having a tracheotomy. In our own experience, however, the incidence of post-tubal stenosis in the diphtheria cases has been definitely much lower than formerly.

Concerning the paralyses mentioned by Dr. Taylor, we have never had residual paralysis in diphtheria unless there was cerebral damage. Thrombosis may occur in the brain and the resulting paralysis will be permanent.

We are strongly in favor of mass immunization on a universal plan as the only real safeguard. There is no evidence to show that immunization lowers the immunity that develops under natural conditions. In fact, the case is entirely the opposite. The number of carriers has dropped markedly since immunization has been widespread.

The question of recognition of the disease by its odor depends on the keen sense of the observer. Diphtheria, as well as the other infectious diseases, has a marked odor sometimes thought to be characteristic. However, when it comes to the real test, recognition when blindfold, I have never been able to substantiate the claim. I believe such odors as do appear are due to secondary invaders, such as saprophytes. They certainly are not present in diphtheria cultures.

Tissue Changes in Sinus Membranes After Treatment with Penicillin

R. A. FENTON, M.D.

PORTLAND, ORE.

(This paper appeared in full on page 245 of the June 1947 issue.)

DISCUSSION

DR. A. W. PROETZ: This paper is important because it deals with a subject on which there has been so much unscientific generalized superficial observation. Our findings have been the same as Dr. Fenton's, so far as the clinical use of penicillin is concerned. In chronic cases we feel that it is practically useless. In the acute cases it probably has considerable value.

We must remember that there is a difference between treating the nose and treating the sinus. The time element is important, because fluid remaining in the sinus over a period of time can do damage which fluid in the nose will not do, since it does not stay in it long enough. Our own observations on the effects of penicillin have

shown that, as the concentration is increased beyond 250 units per cc. the vigor and persistence of the ciliary beat are reduced. This is important, since ciliary activity corresponds to the viability and physiologic response of the cell itself.

(In response to a query from Dr. Imperatori, Dr. Fenton stated that he had had no experience in the use of the so-called aeropenicillin.)

Chordomas of the Cervical Region

C. J. IMPERATORI, M.D.

NEW YORK, N. Y.

(This paper appeared in full on page 271 of the June 1947 issue.)

DISCUSSION

DR. J. J. SHEA: These tumors are rare and the pathologic diagnosis is often a source of argument. In the one case I wish to report, the specimen was studied for nearly three months before we could come to a satisfactory conclusion. Our case was in a woman whose chief complaint was vertigo. The tumor was found in the region of the sphenoid sinus. Attempts to secure biopsy specimens via the postantral route resulted in trauma to the internal maxillary artery, necessitating ligation. This patient has been under observation for 19 years, and regular x-ray studies have revealed no increase in the size of the tumor. It fills the sphenoid cavity and extends into the ethmoid. The type of cell found in the biopsy specimen had a very foamy cytoplasm and an intercellular material not truly cartilaginous.

DR. ROBERT F. RIDPATH: At the time I reported two cases before this Association I could find only three cases in the literature. In the first case there was a history of a blow on the head causing unconsciousness. There were no symptoms for six months, when nasal obstruction and bleeding were observed. The bleeding continued up to the time of his death. Vertigo was a prominent symptom, as it was in Dr. Shea's case. I have seen three cases altogether, and in all of them there were eye symptoms leading to eventual blindness.

The history in these cases is very important and emphasizes the importance of careful examination of the epipharynx.

Dr. Edwin N. Broyles: I should like to report a case in a 21-year-old Puerto Rican girl, whose first intimation of the trouble was the appearance of a mass in the pharynx. It looked like a cyst, but when incised was found to extend through the anterior vertebral ligament. Though not encapsulated it came out easily and looked like fat. Section showed it to be mucus.

Dr. C. J. Imperatori (in closing): Dr. Broyles' case was similar to mine, except that the growth was located higher up, but in a place where pressure symptoms did not appear. His slides showed typical celliferous cells; that is, large vacuolated cells with the nucleus at the periphery. In my case the mass was lower down, extending from the third to the sixth cervical vertebra. The thing I wish to stress is the confusion in diagnosis. It would seem imperative, therefore, that more than one pathologist examine the specimen. In my case it was seen by three men and, eventually, the original diagnosis of mixed tumor and liomyoma was reversed, when the true nature of the growth was revealed through further examination and consultation among the three men.

Presentation of Instruments

Dr. Charles J. Imperatori showed an improved laryngeal loop attached to a regular head mirror, permitting the use of either eye and affording a magnification of three and a half diopters. The apparatus can be rigged up by having a swivel attached to an ordinary optical loop. The head mirror is fitted into the swivel.

Dr. Edwin N. Broyles presented a bronchoscope having a small metal tube attached to its orifice through which a stream of compressed air may be passed across the opening of the tube. By this means the exhaled air is blown away from the operator, thus preventing fogging of the glasses.

Rhinoscleroma in Two Native-Born Brothers

D. S. Cunning, M.D.

New York, N. Y.

The details of two cases of rhinoscleroma in native-born brothers are given. The first was observed over a period of five years before he succumbed to asphyxia when his tracheal tube became obstructed. The other has been under observation for two years and also has to

wear a tracheal cannula because of laryngeal obstruction. Histologic sections are presented, with a description of the various characteristic findings. The author has observed eight cases of rhinoscleroma over a period of years, but was never able to substantiate the claim by others of a probable association of this condition with tuberculosis.

DISCUSSION

Dr. I. H. Blaisdell presented a case of his own.

According to Chapman, an expert in this phase of bacteriology, the Klebsiella type C is always found in rhinoscleroma. This germ has been called the Friedlander bacillus, Frisch's bacillus and mucosus capsulatus by other observers. Despite this finding, we have to agree with Dr. Cunning that the true etiologic agent of rhinoscleroma is still uncertain.

Streptomycin was used in our case and the Kodachrome slides taken over a period of time show a definite diminution in the size of the lesion.

Dr. Fred W. Dixon: It is interesting to have reports on the progress of these cases over a period of years. I have had one case under observation for 13 years, during which time I have had to remove granulation masses from the trachea six times, followed with x-ray therapy; also, masses were removed from the nose several times. When seen recently the patient was feeling well and able to breathe well. I believe that radiotherapy is very helpful in making these patients comfortable even though it cannot cure them.

Dr. LeRoy A. Schall: I have followed one patient for 15 years who has had radiation and plastic surgery and still the disease continues to progress. This disease is quite prevalent in the Latin American countries, and it is likely that we may see it more frequently here, due to rapid transportation and increased inter-country travel.

Dr. Blaisdell's report of the favorable influence of streptomycin is indeed heartening, since up to the present time neither surgery nor irradiation has proved to be more than palliative.

Dr. Cunning (in closing): Dr. Blaisdell's pictures showing the favorable influence of streptomycin were extremely interesting.

In the first series which I reported five years ago, we employed sulfonamides in six cases and noted an initial improvement. This, however, was due merely to control of secondary infection. The original lesions failed to show any change. In the last case, just re-

ported, we used penicillin without much success. Now that Dr. Blaisdell has had such success with streptomycin, we certainly intend to try it ourselves.

Pulsion Diverticulum of the Hypopharynx and its Surgical Treatment

C. L. JACKSON, M.D.

PHILADELPHIA, PA.

Zenker, who first described this condition, was under the impression that it was due to a tear in the musculature of the hypopharynx. Today we know that it is in reality a herniation through a weak triangle formed by the converging longitudinal muscle fibers just above the cricopharyngeus. This anatomic factor was recently well described in a study by Brandenburg. In addition it is believed that failure of the cricopharyngeus to relax at the proper moment in deglutition acts as a predisposing factor. The symptoms and diagnosis are well known. While several surgical procedures have been employed at various times for the eradication of the sac, we have had our best results from a one-stage operation with or without the esophagoscope. Two hundred patients have been operated on by this method in our hospital, with only a one per cent mortality. The operation is done under block anesthesia with the aid of some intravenous pentathol. The incision is along the sternomastoid, care being taken to avoid the lobe of the thyroid. The esophagoscope is useful for checking the location of the sac and keeping the sac clean. There was only one case of recurrent paralysis.

Bronchoscopy in the Diagnosis and Treatment of Bronchiectasis in Children

D. E. S. WISHART, M.D.

TORONTO, CANADA

(This paper appeared in full on page 404 of the June 1947 issue.)

DISCUSSION

DR. LOUIS H. CLERF: I have been converted to the need for general anesthesia in these cases after observing failures following surgery, due to inadequate preliminary bronchography. If the sur-

geon fails to remove all of the diseased lung on the basis of the information given him preoperatively, we must conclude that something was wrong with the bronchography. We appreciate the need for meticulous attention to details and the importance of close cooperation with the roentgenologist. I am not familiar with the intubation tube Dr. Wishart uses for the ether feed. Otherwise, our procedure is similar. We aspirate all secretions and pass a nasal catheter into the trachea, where it is guided under fluoroscopy to the desired portions of the tree.

DR. ROBERT L. GOODALE: Dr. Wishart's paper is timely because it emphasizes the importance of early diagnosis. One-third of all cases arise in the first decade of life and frequently adequate therapy is not applied until much too late.

I agree that the danger of a general anesthetic for this procedure has been exaggerated. Certainly if the chest surgeon can operate under a general anesthetic, I can not see why it should not be as safe for the diagnostic procedure. I would like to ask Dr. Wishart whether he has used other forms of anesthesia, such as intravenous or rectal.

DR. LYMAN G. RICHARDS: I have had the pleasure of working with Dr. Wishart and appreciate his meticulous care in following out the details he described. I also agree that general anesthesia is safe, and by far the preferable method, provided that the entire operation is carried out in one room. Moving the patient from the anesthesia room to the x-ray room involves a risk and diminishes the chances of success.

DR. C. L. JACKSON: I am in complete agreement with Dr. Wishart as to the importance of bronchography, one lung at a time so that every segment may be adequately outlined. Proper teamwork undoubtedly accounts for the success he has attained. This is not always obtainable. As a rule I do not favor general anesthesia, having been in the habit of doing it under local anesthesia with some premedication. We use the nasal catheter guided into the bronchial tree under fluoroscopy. Occasionally we find it necessary to pass the catheter directly through the laryngoscope.

DR. PAUL H. HOLINGER: Speaking of general anesthesia brings up the question of building codes of various cities. We are not permitted to use general anesthesia in any x-ray room where the apparatus is not only shock-proof but explosion-proof as well. This is often difficult to obtain.

DR. WISHART (in closing): Replying to Dr. Goodale's query, we have had no experience with other methods of anesthesia. We have followed the advice of our anesthetist and thus far have received no encouragement to deviate from our established methods. Dr. Holinger's point as to safety is well taken. In our locality we have had no trouble in meeting the requirements of the building code.

The intubation tubes I use are little metal cylinders about two inches long and open at both ends, introduced by means of a long straight steel tube which is withdrawn after the small tube is properly placed. The pictures show them as being bent, which is difficult for me to explain.

Abstracts of Current Articles

EAR

Fenestration of the Labyrinth.

Popper, O.: J. Laryng. and Otol. 61:441-458 (Aug.) 1946.

The author presents a detailed description of his technique for fenestration of the labyrinth, with excellent illustrations. He describes his own headgear: light, magnification and stereoscopic system. Prisms are used, adjustable to the operator's interpupillary distance, thus bringing about convergence without tiring the eyes. A four-diopter lens in front of the prisms gives about one and one-half magnification and a working distance of six and one-half inches. General anesthesia is used.

The unique feature of Popper's technique is the approach which is through an incision just anterior to the tragus. Dissecting medially along the anterior aspect of the tragus and the cartilage of the external auditory canal, he enters the lumen of the canal through an incision in the skin at the lateral edge of the tympanic plate. This bony wall is then removed. The incision in the skin lining the external auditory canal is continued on around the entire circumference about a half inch from the ear drum, and skin and periosteum are elevated medially in to the drum. The margin of the posterior half of the ear drum is separated from the sulcus tympanicus. This loosened tympanic membrane and the surrounding cuff of skin and periosteum are gently tucked into the recess between the remaining portion of the tympanic plate and the anterior part of the drum. The outer attic wall is taken away, and the incus is removed. The author then makes the fistula into the antero-lateral aspect of the dome of the vestibule, further forward than heretofore. The drum membrane is allowed to fall back into its natural site, and the meatal portion of the tympanic flap is placed over the fistula.

The author states that he has performed this operation on a small number of patients, but the cases are said to be too recent to warrant recording.

HARKINS.

The Influence of Sulfonamides on Labyrinthitis and on Indications for Operative Interventions in the Inner Ear.

Hlavacek, V.: Acta Oto-Laryngologica 35:258, 1947.

The effect of sulfonamide therapy on seven cases of labyrinthitis following acute otitia media and on five cases following chronic otitis media was observed with regard to the necessity for labyrinthectomy. The clinical indication of a rising cell count in the cerebrospinal fluid was adhered to. Six of the seven cases following acute otitis media responded without radical surgery but all of the patients with chronic labyrinthitis required a labyrinth operation. The author concludes that sulfonamide therapy does not influence the course of labyrinthitis in chronic cases.

HILL.

Closure of Perforations of the Tympanic Membrane.

Dunlap, Albert M., and Schuknecht, Harold F.: Laryngoscope 57:479-490 (July) 1947.

Dunlap and Schuknecht have revived an old method of closure of perforations of the tympanic membrane. Weekly applications of trichloracetic acid are made to the margin of the defect in the drum. The procedure is carried out under local anesthesia with Bonain solution (cocaine, menthol, phenol). The entire rim of the opening is lightly touched by a small copper or silver wire which has been dipped in the acid. Included in the management is an occasional application of urea and removal of marginal exudates when they accumulate.

Success is attained in most cases but requires considerable patience and time, the treatment often extending over a period of six months.

Ideal cases are those in which a dry non-marginal perforation is present with a good periphery of drum.

Improvement in hearing and diminution of tinnitus usually follow a complete closure.

VAN ALYEA.

On the Connection Between Cerebrospinal and Intralabyrinthine Pressure and Pressure Variations in the Inner Ear.

Ahlen, G.: Acta Oto-Laryngologica 35:251, 1947.

By a series of experiments on rabbits the author found evidence of direct communication and pressure transmission between the cerebrospinal space and the labyrinth by means of the aquaeductus cochleae. Previous work, notably that of Hughson and of Kobrak, has shown pressure variations to be transmitted from the intracranial space. The author, by using the binocular microscope inserted through the promontory, has observed the passage of fluid from the aquaeductus cochleae synchronously with respiration.

HILL.

Resistance-Measuring of the Eustachian Tube and the Ostium and Isthmus Valve Mechanism.

Dishoeck, H. A. E.: Acta Oto-Laryngologica 35:317, 1947.

In a study of the physiology of the eustachian tube the author finds two factors which ventilate the middle ear during swallowing; the slightly increased pharyngeal pressure, and the sucking pressure of the middle ear. At rest the "ostium valve" protects the middle ear from over-pressure in the pharynx. He also concludes that there is a valve at the isthmus to protect the middle ear which may impede readjustment in sudden changes of outside pressure from low to high, as in sudden descent in an aeroplane.

HILL.

NOSE

Penicillin Therapy in Chronic Suppurative Sinusitis. A Report of 22 Cases.

Boyd, Harold: Laryngoscope 57:460-478 (July) 1947.

Boyd reports favorable results from the application of penicillin locally and intramuscularly in the treatment of 22 cases of chronic sinusitis.

The management of these cases included sinus lavage and such minor surgical measures as were deemed advisable to improve sinus drainage.

Most of the patients became symptom free, but as is usually the case in reports of clinical cures in sinusitis it is difficult to determine which therapeutic measure produced the improvement. Before giving too much credit to penicillin an attempt should be made to

ascertain how much should be allotted to the antibiotic and how much to the periodic removal of toxic exudate and the establishment of adequate drainage channels.

VAN ALYEA.

PHARYNX

"Pentothal" For Tonsillectomy in Children.

Fox, Samuel L., and Shane, Sylvan M.: Southern M. J. 40:848-851 (Oct.) 1947.

The author reviews 500 tonsillectomies in which pentothal is used as the anesthetic without serious complications.

"It is necessary to maintain a clear airway with adequate exposure of the field of operation. For this purpose we have found the Davis mouth gag ideal since it permits the simultaneous administration of nitrous oxide and oxygen. The second important factor is the use of nitrous oxide (or ethylene) under pressure as an analgesic in order to diminish the total dose of 'pentothal'.

"Should a laryngospasm occur the nitrous oxide is turned off, 100 per cent oxygen is forced through the gag, and no additional 'pentothal' is injected since 'pentothal' tends to potentiate the spasm rather than relieve it. As carbon dioxide is built up because of the spasm it is important to maintain the integrity of the respiratory center and not paralyze its ability to innervate the muscles of respiration and the vocal cords by deepening the patient with further 'pentothal'. Should the spasm persist, atropine may be injected into the 'pentothal' tubing. Curare may also be injected to relieve the spasm but it is important to use a separate vein, as a precipitate forms when the two drugs mix.

"Although 'pentothal' for tonsillectomy proved successful in children, we feel that its routine use is not practical in children under ten years of age."

TAYLOR.

Carcinoma of the Tonsil.

Walker, J., and Shulz, M.: Radiology 49:162-167 (Aug.) 1947.

Ninety unselected cases of carcinoma of the tonsil treated by irradiation are reported. The period 1936 through 1945 is embraced. The median age of the patients was 65 years. Presenting

complaints were soreness of the throat in 54 per cent, swelling of the neck which was the first sign in 46 per cent; only 9 per cent observed a growth in the mouth.

Eight per cent of the tumors were of low grade histologically. Fifty patients were treated with high voltage (200 k v) and 40 patients with super-voltage (1000 or 1200 k v) radiation. As much radiation is directed into the tumor as can be tolerated by surrounding tissue.

Five-year survival rate was 15 per cent. Twenty-five per cent of those without metastasis survived five years as compared to nine per cent of the metastatic group.

Super-voltage irradiation produced a significant increase in the percentage of five year survivals as compared with high voltage therapy.

JORSTAD.

Some Commonly Unrecognized Diseases of the Nasopharynx.

Hollender, A. R.: Southern M. J. 40:248-251 (March) 1947.

"In the light of present day advances in medicine, there can be no reasons why the nasopharynx should be regarded as an 'unknown' area for diagnostic and pathologic study, nor is there any justification in excluding that organ from the course of routine physical examinations.

"The comparatively frequent incidence of Thornwaldt's disease, tuberculosis and neoplasms of the nasopharynx cannot be disregarded. Furthermore, the frequent incidence in the cavity of focal infectious lesions suggests the importance of these sources in relation to systemic disease of obscure etiology.

"Finally, as a result of our pathologic study as well as extensive clinical experience, there is no doubt that in the past nasopharyngeal diseases have eluded recognition not because of our inability to interpret any findings, but rather because of negligence, carelessness or inability in exploring the pharynx as a whole."

TAYLOR.

BRONCHUS

Bronchiectasis; Some Medical Features Among Military Personnel.

Cohen, S.; Radiology 49:192-199 (Aug.) 1947.

One hundred and one patients with bronchiectasis, diagnosed by bronchography, were admitted during a four-year period (1942-45) to a large army hospital. Essential clinical and roentgenographic features with five case reports and representative roentgenograms are discussed. Eighty-eight soldiers had the disease prior to induction; 78 were discharged from the service and 10 were returned to limited duty.

Bronchiectasis may exist in the absence of classical signs and symptoms. Thirty-nine of the hospitalized soldiers had relatively negative roentgenograms. Bronchography is the only certain method of confirming the diagnosis.

The etiology, treatment and particular role of primary atypical pneumonia in the development of bronchiectasis is discussed and literature on the subject cited.

JORSTAD.

The Pathogenesis of Bronchiectasis.

Mallory, T. B.: New England J. Med. 237:795 (Nov. 27) 1947.

Bronchiectasis is considered to be a disease of the pulmonary parenchyma as well as the bronchial tract. This parenchymal involvement results in a marked reduction in aerated alveoli which lowers intrathoracic pressure, thereby generating an effective dilating force on the bronchial walls. The lack of aerated alveoli renders cough ineffective as a means of clearing bronchial secretions, thereby predisposing to stagnation.

Chronic bronchial infection, congenital abnormalities of the bronchial tree, bronchostenosis, atelectasis, and pneumonitis or its sequel pulmonary fibrosis, all may be potential factors in the production of bronchiectasis. Of these, congenital cystic disease and bronchostenosis are comparatively uncommon. Bronchial infection alone is rarely a factor but in combination with atelectasis or pneumonitis probably accounts for most cases.

The most hopeful prophylactic measure in the prevention of bronchiectasis is the prevention or prompt alleviation of atelectasis.

HILL.

MISCELLANEOUS

The Management of Respiratory Embarrassment in Poliomyelitis.

Fox, Max J., and Sanders, Donald D.: Wisconsin M. J. 46:885-894 (Sept.) 1947.

Mechanics of Respiration.—During inspiration the thoracic cage enlarges thereby decreasing the intrapulmonary pressure so that air flows into the lung. This negative pressure varies from 2 mm. of mercury during quiet breathing to 40 or 50 mm. of mercury during forced inspiration. During expiration the pulmonary cage contracts raising the intrapulmonary pressure 3 to 4 mm. of mercury during quiet expiration and as much as 10 to 40 mm. of mercury during forced expiration.

Ordinary expiration is passive. It depends upon the elastic recoil of the pulmonary tree and return of the chest cage to its original position. Forced expiration is brought about by the action of the abdominal and the latissimus dorsi muscles.

The respiratory center is located in the brain stem. It is believed that the accumulation of carbon dioxide in the blood stimulates the respiratory center to send impulses to the muscles of inspiration. Toward the latter part of the inspiratory phase the elastic stretch of the lungs initiates impulses which travel up the vagi to the brain stem to inhibit inspiration, thus resulting in "passive" expiration.

The respiratory center can also be stimulated by impulses arising from the carotid body, aortic arch, cerebrum, skin and skeletal muscles.

Mechanism of the Cough Reflex.—Smith has stated that the ability to cough is the only indication for removing a patient from a respirator. The cilia of the trachea and bronchi propagate particulate matter and secretions toward the mouth. Afferent impulses arising from the irritation of these secretions on the larynx, trachea and bronchi are transmitted to the brain stem via the vagi. Impulses are then sent to the motor neurons innervating the muscles of inspiration and expiration. There is a forced inspiration; the glottis closes; the muscles of expiration, especially the abdominal muscles, contract; the intrathoracic pressure increases, then the glottis suddenly opens and there is an explosive expulsion of air. Thus the cough is initiated in an attempt to expel the irritating substances.

Mechanism of the Respirator.—A respirator attempts to simulate the normal mechanism of respiration by producing pressure

changes around the body of the individual. When the pressure surrounding the body is reduced below that of the atmospheric pressure, air flows into the lungs and distends them. The minimal negative pressure is employed which makes the patient feel comfortable and provides adequate oxygenation. It must be increased after meals and while hot packs are used because of the increased metabolism these factors produce. During the night increased negative pressure makes the patient feel more secure. He also requires increased negative pressure when he has been temporarily out of the respirator.

According to Wesselhoeft children under ten should be started at a negative pressure of 10 cm. of water and it should not be increased above 14 cm. Adults can be started at a negative pressure of 12 to 14 cm. but it should not be increased above 20 cm. If the negative pressure is too great, emphysema, bronchopneumonia or alkalosis may result.

The rate of the rhythmic changes of pressure is not as important as the height of the negative pressure. The rate for children is usually between 20 and 30 per minute and for adults between 15 and 20 per minute. Too rapid a rate may produce alkalosis.

Positive pressure is seldom used. Stimson believes it is contraindicated. When used in conjunction with negative pressure it increases the volume of tidal air which may be of advantage during the acute phase of respiratory distress.

All parts of a respirator must be kept in good operating condition and for this purpose a hospital attendant, preferably an engineer or an electrician, should be charged with its care.

Aspirators are indispensable in the treatment of poliomyelitis with bulbar involvement to prevent aspiration of mucus or food into the lungs. Anderson recommends continuous nasopharyngeal suction in bulbar poliomyelitis using a catheter with multiple holes at its distal portion. The foot of the bed should be elevated in such cases.

Classification of Respiratory Distress in Poliomyelitis.—The respirator is valuable only in certain types of respiratory distress. For this reason an exact etiological diagnosis is necessary. The following classification is useful:

1. Involvement of muscles of respiration.
   a. Paralysis
   b. Spasm

2. Damage to respiratory center.

3. Psychic factors.

4. Obstruction of airways.
   a. Mucus
   b. Paralysis of vocal cords.

5. Pulmonary disease.
   a. Pneumonia
   b. Atelectasis.

The respirator is only valuable when respiratory distress is due to intercostal or diaphragmatic paralysis.

When the respiratory center is involved, no treatment is of any avail. The diagnosis is established when the rate, depth and rhythm of respiration are totally irregular. Periods of apnea, violent hiccups and long sighs may occur. Under this category the author presents two case reports.

When a patient has obtained relief in a respirator during an acute attack of respiratory distress, he dreads being taken out of it. He should be removed from it gradually and an attendant should always be present. His tolerance should not be exceeded and under no circumstances must he be allowed to become unconscious.

The most common cause of obstruction of the airways in poliomyelitis is due to the accumulation of mucus. In the experience of the authors tracheotomy is rarely if ever indicated. If edema is producing the obstruction, conservative therapy, embracing postural drainage, aspiration of pharyngeal secretion and adrenalin sprays to the throat should be used. Even if the obstruction is due to central involvement, Fox and Sanders feel that conservative measures should be employed. Whether tracheotomy should be employed in this circumstance is controversial.

The respirator is indicated in bulbar-spinal poliomyelitis only if the diaphragm and intercostal muscles are involved. In most of these cases there is a paralysis of the pharyngeal muscles and the most important therapy should be directed toward clearing the pharynx of these secretions, thereby protecting the patient from atelectasis and pneumonia as much as is possible.

GROVE.

Otogenic Brain Abscess.

Jongkees, L. B. W.: Acta Oto-Laryngologica 35:225, 1947.

Two cases of brain abscess, one temporo-sphenoidal and one cerebellar, are reported. Each was treated, via the mastoid route, by puncturing the abscess cavity, aspirating pus and injecting penicillin. Penicillin was also used parenterally. Recovery was uneventful. No reference is made in the report to the type of organism.

HILL.

Initial Oto-Neurological Disturbances in Pellagra.

DeRaadt, O. L. E.: Acta Oto-Laryngologica 35:231, 1947.

A symptom complex of vertigo, nystagmus, headache, hearing impairment and weakness of lateral gaze and convergence was observed in a patient in a Japanese prison camp. The author concludes that the lesion was located in the brain stem and that the symptoms were an early manifestation of pellagra. Thiamin, riboflavin, pyridoxin and nicotinic acid were effective in treatment.

HILL.

Arachnoiditis of the Cerebellopontine Cistern.

Hald, E.: Acta Oto-Laryngologica 35:377, 1947.

Four cases of cystic arachnoiditis of the pontine angle are reported. Preoperatively it was impossible to differentiate this from acoustic neurinoma. The author emphasizes that the history, chronology of symptoms, perverted relationship between acoustic and vestibular loss of function and early pressure headache should suggest arachnoiditis.

HILL.

Ménière's Disease and Allergy.

Kjaer, M.: Acta Oto-Laryngologica 35:390, 1947.

While 25 per cent of 340 patients with Ménière's disease were found to present signs of allergy, in none of these was there any evidence of labyrinthine anaphylaxis. The author feels that allergic processes may affect the vestibular apparatus secondarily because of mucosal alterations in the nose and eustachian tube. Apparently many of these cases should be considered as pseudo-Ménière's disease rather than true labyrinthine dropsy.

HILL.

Notices

UNIVERSITY OF FLORIDA MIDWINTER SEMINAR

The University of Florida Midwinter Seminar in Otolaryngology and Ophthalmology will be held at the Flamingo Hotel in Miami Beach, beginning on January 12 and continuing through January 17, 1948. The lectures in Otolaryngology will be presented on the 12th, 13th and 14th, and those in Ophthalmology on the 15th, 16th and 17th. The registration fee is $25.

The lecturers for the courses in Otolaryngology include Drs. Lawrence R. Boies, Minneapolis; Louis H. Clerf, Philadelphia; Kenneth M. Day, Pittsburgh; Thomas C. Galloway, Chicago; James H. Maxwell, Ann Arbor, Mich.; Arthur W. Proetz, St. Louis; and Harry P. Schenck, Philadelphia. Among the outstanding ophthalmologists who will lecture are Drs. S. Judd Beach, Portland, Me.; William L. Benedict, Rochester, Minn.; Daniel B. Kirby, New York; Peter C. Kronfeld, Chicago; and Dohrmann K. Pischel, San Francisco.

The Midwinter Seminar follows immediately the Pan-American Congress of Ophthalmology, which will be held in Havana, Cuba, January 5-10, 1948.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

(List corrected to November 1, 1947)

Aurex (Semi-Portable)

Aurex Model C-B and Model C-A

Beltone Mono-Pac

Beltone Harmony Mono-Pac

Maico Type K

Maico Atomeer

Mears Aurophone Model 98

Microtone T-4 Audiomatic

Otarion, Model A-1

Otarion, Model A-2

Otarion, Model A-3

Otarion, Model A-4 Jr.

Otarion, Model E-1

Paravox Models VV2 and VV3

Paravox Models VH and VL

Paravox Model XT

Paravox Model XTS

Radioear Masterpiece

Radioear 45-CM

Radioear Model 45-M-magnetic air conduction receiver

Radioear Model 45-M-magnetic bone conduction receiver

Ravox (Semi-Portable)

Silver Micronic Hearing Aid

Solopak Hearing Aids

Sonotone Audicles No. 530 No. 531 and No. 533

Sonotone Model 600

Sonotone Model 700

Telex Model 22

Telex Model 612

Telex Model 900

Telex Model 1020

Telex Model 1550

Trimm Vacuum Tube No. 300

Unex Model "A"

Vacolite Model D

Vactuphone Hearing Aid

Western Electric Audiophone Ortho-Technic Model

Western Electric Telephone Type Audiophone, Model J-1

Western Electric Model 63

Western Electric Model 64

Zenith Radionic Model A-2-A

Zenith Radionic Model A-3-A

Zenith Radionic Model B-3-A

Zenith Model 75

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President: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis 8, Mo.
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Meeting: The Homestead, Virginia Hot Springs, April 14-15, 1948.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Lyman G. Richards, 1101 Beacon St., Brookline, Mass.
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Meeting: Chalfonte Haddon Hall, Atlantic City, N. J., April 7, 8, 9, 1948.

Sections:

Eastern—Chairman: Dr. J. Winston Fowlkes, 12 East 63rd St., New York 21, N. Y.
Meeting: New York, N. Y., January 16, 1948.

Southern—Chairman: Dr. William A. Wagner, American Bank Bldg., New Orleans 12, La.
Meeting: New Orleans, La., January 23, 1948.

Middle—Chairman: Dr. Hugh G. Beatty, 150 E. Broad St., Columbus, Ohio.
Meeting: Columbus, Ohio, January 19, 1948.

Western—Chairman: Dr. Meade Mohun, 23 Second Ave., San Mateo, Calif.
Meeting: San Francisco, Calif., January 31-February 1, 1948.

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.
Secretary: Dr. James M. Robb, 641 David Whitney Bldg., Detroit, Mich.
Meeting: Chicago, Ill., June 21-25, 1948.

American Otological Society

President: Dr. Bernard J. McMahon, 634 N. Grand Ave., St. Louis 3, Mo.
Secretary: Dr. Gordon D. Hoople, Medical Arts Bldg., Syracuse 3, N. Y.
Meeting: The Homestead, Virginia Hot Springs, April 12-13, 1948.

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